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ABSTRACT

OF THE

REPORTS OF THE SURVEYS,

AND OF OTHER

GEOGRAPHICAL OPERATIONS

IN

INDIA

FOR

1876–77.

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PRINTED AND PUBLISHED BY ORDER OF
HER MAJESTY'S SECRETARY OF STATE FOR INDIA IN COUNCIL.

LONDON:
SOLD BY
W. H. ALLEN & CO., 13, WATERLOO PLACE;
EDWARD STANFORD, 55, CHARING CROSS;
N. TRÜBNER & CO., 57 & 59, LUDGATE HILL;
W. B. WHITTINGHAM & CO., 91, GRACECHURCH STREET;
W. THACKER & CO., 87, NEWGATE STREET.

1878.

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I.

Marine Surveys of India, 1876–77.

The Indian Marine Survey Department is now in active operation, and the general report for 1876–77 (the second issued) shows the completion of many urgently needed pieces of survey work at various points along the coast of British India. Among these Commander Taylor's inspection of the Burmese coast calls for prominent notice, a trip partly prompted by the fact that the British India Steam Navigation steamer "Moulmein" had struck on a rocky shoal in Tavoy River in September 1875, and in the following February the steamer "Mahratta" had struck on another rock in the same river, whilst neither of these dangers was marked on the charts. In the course of this tour Commander Taylor visited Akyab, Bassein, Rangoon, Amherst, Moulmein, Tavoy, Mergui, and the Pakchan River, besides the ultra-Indian ports of Kopah and Junkseylon. Commander Taylor came to the conclusion after this inspection that no large port of British India required surveying so much as Amherst, and accordingly made arrangements for its survey by Lieut. Jarrad in the "Clyde" in the season 1877–78. The Admiralty Chart of Tavoy proved to be very erroneous; but subsequently Commander Taylor discovered an older survey of Tavoy executed in 1824 by Lieut. (afterwards Captain) Robert Moresby, of the Bombay Marine, which, proving to be far better than the published chart, was photozincographed and issued (with a few corrections) for local use. For the intricate passages between Mergui and Pakchan no sailing directions exist, but Commander Taylor proposes to issue these in the form of hydrographic notices, explanatory of the normal trading route between Moulmein and Pakchan, touching at Tavoy and Mergui, with some useful remarks on the extended voyage along the Siam coast to Penang. Below Pakchan Commander Taylor has made a sketch showing the soundings in the entrances to the Kopah River, which has important tin mines, but no trace of such a fine river as depicted on the existing chart. Of Junkseylon or Salang a pretty good survey was obtained from Captain de Richelieu, commanding the Siamese Royal gun-

boat "Coronation," an officer who was trained in the Royal Navy, and is a good and energetic surveyor. The new survey of Junkseylon differs greatly from the old one, and the new chart will be a great boon to the British India Steam Navigation Company and the coasting trade. On the whole Commander Taylor's cruise was a most fruitful one, and he considers that a two months' cruise among the islands of the Mergui Archipelago would fairly supplement the charts of Ross and Lloyd, while the naturalist would have ample scope for making good collections of the fauna and flora, the islands being densely wooded and rich in metals.

Commander Taylor made some full reports as to how Rs. 30,000 could be best spent in the interests of False Point Harbour, a question to which his attention was invited by Government. He is of opinion that Dr. Hunter (in his "Orissa") is mistaken in supposing that the Mahanadi is scouring out a harbour here, the process being rather one of silting, though to a very slight extent. The muddy matter deposited has caused False Point to advance at the rate of about 40 yards annually since 1835. Commander Taylor considers False Point to be a most valuable and safe port for small vessels, and the key to Orissa.

A visit was also paid by Commander Taylor to the harbours of Marmagao and Carwar, with the object of testing their relative merits as sheltering anchorages during the S.W. monsoon. On the whole he considers Marmagao the superior of the two as a natural harbour.

Among the surveys executed, that of Madras Roadstead by Lieut. Jarrad, R.N., calls for notice. Considerable difficulty was encountered in making the tide gauge work, owing to the force of the waves even at 4½ fathoms depth, but eventually the gauge worked well, registering the heights of the tides every 15 minutes. The result of the survey was an elaborate chart with soundings sectionally taken in lines 250 feet apart, as far as the 10 fathom line. This survey was afterwards extended by Lieut. Hammond, R.N., to a distance of 3½ miles north and south of the pier. A survey of Chittagong (Karnafuli) River was commenced by Lieut. Hammond, with the main object of making the approach to the river better lighted by night. Commander Taylor also repaired thither, and, having inspected the Norman Point and Kootubdeah lights, and determined the place to which the former might most advantageously

be removed, he directed the abandonment of the survey, as cholera (first induced by the tainting of the water through the calamitous storm wave) had become very rife.

Another survey of importance was that of Moulmein River, executed by Lieut. Jarrad in the "Clyde." Sounding work was much impeded by the great strength of the tidal stream during spring tides, but nevertheless an elaborate sectionally-sounded double-elephant sheet was completed comprising 105 square miles of water closely examined and 36 miles of coast trigonometrically laid down. Lieut. Jarrad obtained a true bearing of Double Island Light House from Amherst Point, and discovered it to be $1\frac{1}{2}$ miles to the westward of its true position, notwithstanding that the island and adjacent coast had already been shifted a distance of $4\frac{1}{2}$ miles to the eastward of the positions shown on the Admiralty Chart. Lieut. Jarrad also measured a meridian distance between Amherst Point Pagoda (Moulmein River) and Diamond Island (Cape Negrais) with eight chronometers, the errors of which were determined by six sets of observations of equal altitudes of the sun's limbs and centre. The "Clyde" then proceeded to Akyab to complete the survey of that port (commenced last year), but the prevalence of cholera unfortunately prevented it. The completion of this survey is urgently required, since both as a harbour of refuge, and as a place of export of rice, Akyab is much frequented, and several wrecks have lately occurred in the vicinity.

In the Marine Survey Office a tabular statement has been under preparation showing the cost of erection and maintenance of all lighthouses and light vessels of British India, together with their positions, distinction, characteristics, &c. The annual list of the same, published in its abbreviated form, has been issued for 1877, and the annual returns of wrecks and casualties for the years 1876 and 1877 have been also prepared. Arrangements were not completed during the year under review for the establishment of a Chart Depôt at Calcutta, but recently the Lords Commissioners of the Admiralty have signified their assent to the sale and hand correction of Admiralty Charts by the Indian Marine Survey Department, so that it may be anticipated that a General Chart Depôt, based on the well-tried and excellent system of the Hydrographic Department of the Admiralty, will soon be in full working order in Calcutta.

The charts issued during the year from the Drawing and Compiling

Branch under Mr. R. C. Carrington comprise the following, Madras Roadstead (20 inches to the mile); False Point to Mutlah River, showing the approaches to the Sand-Heads; Puket or Tonkah Harbour, with part of the east coast of Junkseylon; Salang Island or Junkseylon by Captain A. de Richelieu; Tavoy River; Goa and Marmagao Roadsteads (a much-needed chart, no chart of this important anchorage having hitherto existed); False Point anchorage; Kopah Inlet; and a magnetic chart of the Indian Ocean, showing the curves of equal magnetic variation. Besides these, photozincographed copies of Admiralty Charts have been issued, various miscellaneous drawings and tracings have been prepared, and no less than 3,279 charts have been corrected for newly discovered dangers, new lights, buoys, &c.

The natural history researches under Dr. James Armstrong, B.A., M.B., F.L.S., of the "Clyde," have included a fair ornithological collection, among which were two specimens of a bird apparently new to science, *Totanus Haughtoni*, and several interesting specimens of Echinoderms, Crustaceans, and Molluscs. The greater part of the collections was made in the eastern part of the Irrawaddy Delta, where the marine zoology is extremely small and scanty, but the littoral fauna on the contrary is abundant, a crimson stalk-eyed crab (*Ocypode platytarsis*) especially swarming in such numbers as to give the beach in parts the appearance of an extended surface of crimson.

The more immediately pressing marine surveys are the bay and river of Jaigurh, the Chaul Kadu, and other reefs off Alibag, below Kenery island (which, combined with some sectional soundings in the harbour, would enable a useful chart to be compiled of the approaches to Bombay, exhibiting the coast line from Mahim to Chaul on one large sheet), Anjanwel or Dabhol river mouth, and the banks and shoals recently sprung up off Gogah and Bhaunagar, which is now being connected by rail with Wadhwan on the Bombay, Baroda, and Central India Railway. Tuticorin, Cochin, Beypore, and Mangalore are also to be examined during the ensuing 12 months or so by Mr. Morris Chapman, I. N.

In November 1879 it is anticipated that the new surveying steamer will be ready, and she will be able to carry nearly all the Surveyors of the Department. The more important surveys then requiring attention will comprise the Orissa Coast from Dhumra

River to Chilka Lake; the Ganjam Coast to Bimlipatam; Akyab Port and its approaches, including the Oyster Reef light; entrance to Bassein River, including Diamond and the Phaeton shoal with Alguada reef, also the coast adjacent; the mouths of the Irrawaddy River; the Baragua flat; the Krishna shoal and coast line into the Gulf of Martaban and as far round as Amherst; and, lastly, the Gulf of Cambay, an important field for survey, as its shore line and banks have undergone great changes during the last 40 years.

The above surveys will probably occupy the Department for about the next five years, but Commander Taylor expects to be able to arrange also for the examination during that period of ports where high banks and shoals periodically grow or change, such as False Point, Coconada, Dhumra River mouth, and Chittagong; also preliminary sketches of hitherto uncharted small ports, such as Sandoway, and Gwa on the Burma coast, of Bhaunagar, Gogah, Shial-bet and Diu Head on the Kattywar coast, as well as Cheduba Strait, the coast in the vicinity of Tavoy, and the Andamans, where several good anchorages are reported, which would be of great value to vessels leaving India in June, July, and August. Another locality requiring attention is the Mergui Archipelago, where a two or three months' tour is needed.

The Drawing Branch, having produced five general charts of the coast of British India, wishes to publish large scale sheets of many localities where trade has greatly increased during the last two or three years. On his periodical tours round the coast, Commander Taylor has ascertained from the various local marine and mercantile authorities many of their urgent requirements for the improvement of navigation which in numerous cases have been met by the Drawing Branch. Commander Taylor is engaged, amongst other labours, in preparing a corrected edition of the West Coast of Hindostan Pilot, as also a first edition of an East Coast of Hindostan Pilot, a work the necessity of which has long been felt by navigators in these seas, so many ports having lately sprung into use of which no mention whatever is made in any sailing direction extant.

The preparation of the annual return of Wrecks and Casualties in Indian Waters is an important duty which has been assigned to the Marine Survey Department, and the returns for 1876 and 1877 were duly issued by the Department, with charts showing the

positions in which the wrecks, &c. occurred. They were compiled and prepared by Mr. R. C. Carrington. The return for 1876 testifies to a larger number of *recorded* wrecks and casualties than any year since the wreck chart was first compiled in 1865; but, although some portion of the increase is no doubt due to the disastrous cyclone of October, yet the majority may be perhaps attributed to the means adopted for obtaining information of every casualty, so that the year under review does not in all probability present actually a larger catalogue of disasters. There were altogether 46 ships of 23,866 tons wrecked (31 of which were British and 11 native craft), with a total loss of 92 lives. There were 64 casualties to vessels, with a loss of four lives, 49 of the casualties being to British vessels. Compared with 1875, this shows an increase of 21 in the number of wrecks, of 27 in the number of casualties, and 31 in the number of lives lost. In connexion with the last must be mentioned 400 lost in the *Hydree* and 428 in the *Javad*, both wrecked in the Red Sea, but not indicated in the limits of the Wreck Chart.

During the 12 years, 1865-1876, the annual average number of reported wrecks and casualties has been 54, the average total tonnage of which was 18,072, and the number of lives lost 79.

The wrecks of the native craft are described as principally due to the rottenness of the vessels, these being very badly constructed, and not fit to encounter the ordinary monsoon weather. Condemned ships are purchased by natives, patched up and sent to sea, and the Marine authorities are powerless to interfere. One vessel wrecked in 1877 had been allowed to go to sea in a rotten condition. In many instances there are neither charts nor compasses on board. A large number of casualties in 1876 were caused by the heavy cyclone at the head of the Bay of Bengal. Of total losses by fire the same year, the *Cauderbout* and *Mysore* were burnt at Calvetty in British Cochin, during the conflagration which destroyed the town on 7 January 1876.

The *China* and *Asia* were burnt through the carelessness of the crew, and three other vessels, as well as a few in 1877, from unascertained causes. A large number of collisions occurred in both years, which were due mainly to the carelessness or unskilful management on the part of the Master or Pilot. Incorrect charts are a very frequent cause of disaster, and it is hoped that the

numerous charts, sailing directions, and notices issued by the Marine Survey Department will partly remedy this. The charts issued by that Department and the Admiralty are kept corrected up to date of issue, and are sold at a low price, yet it has been estimated that about one half of the whole number of British vessels are navigated by old or incorrect charts.

It appears worthy of consideration under these circumstances whether it would not be possible to compel by Act of Parliament all owners of vessels to be responsible for the supply of correct official charts to each of their ships, and insist that no Master should leave a port without having notified what chart he is carrying for the purpose of navigating his vessel. Chronometers, compasses, steering apparatus, and the gear of a ship generally, are as a whole well looked after, and it seems very desirable that the provision of correct charts be so too. Mr. Carrington adds that an experience of nearly twenty years has shown him that a greater amount of carelessness exists among masters of vessels in connexion with this matter than in any of the responsible and laborious duties devolving upon them.

The number of reported wrecks and casualties during 1877 considerably exceeded that of any former year. It was marked by no particular cyclone storms or extraordinary atmospheric disturbances, and the only conclusion to be arrived at is that the former statements have been incomplete. The order lately issued by the Government of India to the various Marine authorities enjoining the observance of greater punctuality in communicating information of wrecks and casualties has doubtless caused a considerable increase in the numbers reported. There were 65 ships of 26,847 aggregate tonnage wrecked, with a total loss of 138 lives; and of casualties there were 98, with a loss of 4 lives. The year 1877 will be remembered as a fatal one in connexion with the wrecks of the *Cashmere* and *Meikong*, near Cape Guardafui, and the total loss of both vessels and cargo.

The question of erecting a lighthouse on or near the Cape is now under the consideration of the various Governments interested, and it has been proposed to defray the cost by tonnage dues levied at Suez.

During the year 1876–77, the personnel of the Marine Survey Department consisted of the Superintendent, 2 Deputy Superintendents, 6 Assistant Superintendents, 1 Superintendent Drawing and

Compiling Branch, 1 Medical Officer and Naturalist, besides clerks and subordinate officials. There were three vacancies, all among the Assistant Superintendents.

The cost of the Department for the year under review was 14,048*l.*

II.

Great Trigonometrical Survey of India, 1876–77.

During the year 1876-77 the out-turn of the above Department has been as follows:—Of Principal Triangulation, 67 triangles have been measured, covering an area of 5,019 square miles, and astronomical azimuths of verification have been measured at two of the principal stations. Of Secondary Triangulation, an area of 5,400 square miles has been closely covered with points for the Topographical Survey; an area of 3,100 square miles has been operated in *pari passu* with the principal triangulation, and in an area of about 23,600 square miles, lying mostly in portions of the Himalayas, which are inaccessible to Europeans, a number of points have been fixed which will be valuable for geographical rectifications. Of topography 5,303 square miles have been surveyed on scales of $\frac{1}{2}$ inch, 1 inch, and 2 inches to the mile, and geodetic operations, determinations of longitude, and geographical explorations beyond the frontier have been also carried out.

The Madras coast series was conducted northward towards Tanjore by Captain Carter, who took charge of the party from Lieut.-Colonel Branfill. Every endeavour was made to identify the old stations of Colonel Lambton, erected in 1800, but only in one case was this successful, a circumstance which shows the necessity of taking measures for the permanent protection of the stations. Colonel Branfill records some interesting notes on the nomenclature of the district, which are included in the Appendix to the Report. Lieut. Harman carried the Assam Valley Triangulation to within a few miles of Sadiya, and effected a junction with the work of Lieut. Woodthorpe, of the Topographical Survey, in spite of heavy rains which flooded the country to a great depth. From the Eastern Frontier series in British Burmah four chains of secondary triangulation were carried in various directions over the face of the country, and a number of points have been thus fixed for the opera-

tions of the Revenue Survey whenever financial considerations will permit the latter, which has been strongly recommended by the Chief Commissioner, to be taken up.

The main chain of the Eastern Frontier triangles was carried forward by Mr. Beverley for a distance of 92 miles along the Tenasserim Coast as far as 14° S. latitude, or nearly as far as Tavoy. The "Three Pagodas," a well-known boundary mark between Siam and Tenasserim, unfortunately could not be fixed, owing to bad weather. The connexion of Bangkok, the capital of Siam, with the Great Triangulation of India is of great importance, as the distance by sea from Tavoy to Bangkok is over 2,000 miles, and a direct triangulation by land, being but little over 100 miles, would be of great value as a check upon the various Marine Surveys which have been made along the coast.

Captain Rogers having completed the Jodhpur Series took up the Eastern Sind Series, and carried it northward for a distance of 125 miles through the Thar and Parkar, Jeypore and Jeysulmere deserts, where sandhills and lack of water greatly hindered progress. The above comprised the whole of the principal triangulation completed during the year.

With regard to the Topographical Surveys, a good out-turn of work was rendered by Major Pullan, who was in charge of the Kattywar party, and was employed in the south-western part of that peninsula. This Survey has progressed so far that the preliminary triangulation will be extended into Cutch next season with a view to the detailed survey of that tract. The maps recently published are remarkably clear specimens of photozincography.

The Guzerat Topographical Survey progressed under the successive control of Lieut.-Colonel Haig, its normal chief, Lieut. Gibbs, and Captain Carter, and an area of 1,988 square miles (described as a very satisfactory out-turn) was surveyed on the scales of two inches to the mile for British districts and one inch for Native States. An excellent historical and statistical account of the country was furnished by Lieut. Gibbs, who has contributed valuable papers to previous reports. Most unfortunately this young officer, whom Colonel Walker describes as one of the finest and most valuable of the officers of the Department, died of cholera on the 21st November 1877.

The Survey of Kumaon and Garhwal, which had been in abeyance

during the season of 1875–76, was completed in 1876–77, though an exceptionally late and severe winter hindered the early resumption of operations in this lofty region. Mr. Ryall in his survey of Hundes and neighbouring peaks ventured across the frontier, but this fact was very soon reported to the Tibetan officials, who however gave him leave to complete his work on condition that he did not cross the Sutlej. The Byans Valley was surveyed by Mr. Peyton, who reports that during the season there is considerable traffic on the main road, and that several parties of Tibetan traders bring down by this route to Kumaon flocks laden with salt and borax. The average height of the survey work of this party actually lay above 16,000 feet above the level of the sea.

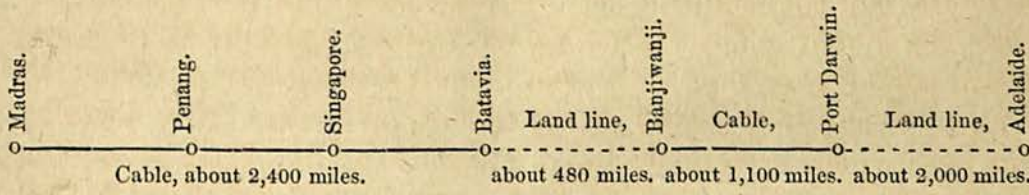
The spirit-levelling operations of the Survey, which have hitherto resulted in numbers of level charts (so useful for canal and railway purposes) of Oudh and the North-West Provinces, have during the year been represented by 358 miles of levelling about Broach, Surat, and Baroda.

Colonel Walker gives a very full description of the method of analysis of the tidal observations in the Gulf of Cutch and at Tuticorin, coupled with the method by which the atmospheric influence on the tides has been calculated. The results are not satisfactory as regards determination of atmospheric influence, but the observations will be again analysed to ascertain whether they can be made to yield more consistent results. Arrangements have already been set on foot for starting systematic observations, under Captain Baird's supervision, at Aden, Bombay, Karwar, and Madras.

The geodetic operations for telegraphic determinations of longitude were carried on by Captains Heaviside and Campbell. These are of great value in checking astronomical and trigonometrical measurements, and during the year under review, besides three arcs of longitude measured between Vizagapatam, Madras, Bellary, Mangalore, and Bombay, the last link in the chain of geodetic connexion between England and India was completed by the telegraphic measurement of the distance between Bombay, Aden, and Suez, the arc between Suez and Greenwich having been measured during the observations for the transit of Venus in 1874. The effect of this measurement is to establish a new value for Madras Observatory (80° 14′ 51·3″ E. of Greenwich) to which all

Indian longitudes are referrible, and to increase the distance hitherto supposed to exist between the two countries by 2,000 feet.

This telegraphic connexion of the longitudes of India and England will probably bear fruit in a further extension of the operations to Australia in the manner shown in the diagram.



Direct signalling would probably be practicable through the cables joined up between Madras and Batavia, so that the measurement might be made in one operation with astronomical stations at the two ends. Then the section, Batavia to Adelaide, might be measured with signallers at only the ends of the intervening cable. The land wire of about 2,000 miles across Australia is a formidable section to work through; but Captain Campbell (who has visited the proposed line with the view to examine the practicability of the arrangements) is of opinion that the dryness of the climate will probably secure success.

In the Head Quarters Office, Major Herschell has continued his researches into the results of pendulum observations for determining the influence of local attraction; and in the Computing Office, the final reduction of the north-east quadrilateral, that section of the Great Triangulation which includes all the principal chains of triangles situated to the north of a line running from Sironj, in Central India, through Calcutta to the Eastern Frontier, and to the east of the meridian of Sironj, has been completed. The second volume of the Account of the Operations of the Survey is still passing through the press.

The forthcoming work of the Great Trigonometrical Survey during the next five years will probably include:—

Principal Triangulation.

(1.) Extension of the eastern frontier series from Tavoy through Tenasserim towards Singapore, with a branch to connect Bangkok, the capital of Siam.

(2.) Completion of the Eastern Sind series on the meridian of 70° between the parallels of 27° and 29°.

(3.) Completion of the Madras Coast series between Madras and Tanjore.

Secondary Triangulation.

(1.) Minor chains in Burma.

(2.) A chain along the western frontier of Sind up to Quettah, and from Quettah to Dera Ghazi Khan.

(3.) Other minor chains possibly in some of the spaces between widely separated principal chains.

III.

Topographical Surveys and Work of Surveyor-General's Office, 1876–77.

The Report on the Topographical Surveys of India and of the Surveyor-General's Department for 1876–77, is the last report issued by General Thuillier, and, besides the usual review of the topographical surveys of India for the past season, contains a very brief account of the various operations conducted under his incumbency as Surveyor-General from 1861, and as Superintendent of Revenue Survey from 1847.

During the past season the number of executive parties was seven in Northern India and two in Mysore, but at its close the Central Provinces and Vizagapatam Agency Survey party, which had completed its work, was broken up; the N.E. division, Central Provinces party, was amalgamated with the Rajputana party, and, owing to the famine, the two parties in Mysore were reduced and amalgamated into one, so that at present the Imperial Topographical Surveys are reduced to only six parties.

The topography executed during the season amounted to 18,909 square miles, on scales varying between half and six inches to the mile, and the triangulation to 22,119 square miles. Much of the geographical data obtained in the Naga Hills, in the eastern frontier of Assam, and in the Central Provinces, is perfectly new, and a good deal in Malwa, Khandesh, and Rajputana, furnishes reliable topography in place of the very rough routes and sketches from which the old existing maps were compiled. The cost of the season's operations (all heads) was 4,81,958 rupees (1,21,161 rupees of which was defrayed by Mysore), and the mean average mileage rate is

25 rupees, 8 per square mile, or somewhat in excess of the previous season; an excess, however, which is duly explained. On the whole the results are said to be very favourable and promising.

The party under Captain C. Strahan, No. 1 (Gwalior and Central India), was engaged in a difficult country along the great water parting of the rivers draining eastwards into the Bay of Bengal, and those which flow westward into the Gulf of Cambay. The contrast between the former, which is a fine open country, forming part of the Rajputana plateau, and the latter, which is a dense forest and jungle-covered tract intersected with watercourses and narrow valleys, is described as very striking. Besides a fair out-turn of field topography, large scale plans of Gwalior fortress and Morar cantonments were completed. A graphic description of the character of the country surveyed finds place in the Appendix to the Report. It is calculated that about seven more seasons will enable the remaining area allotted to this party to be completed.

To the immediate south of the above party an exceedingly good season's out-turn was completed by Captain Wilmer and Lieut. Gore (who were in charge of the Bhopal and Malwa Survey party), their work lying on either side of the Vindhyan Range; still further to the south was engaged the Khandesh and Bombay Native States Survey party, under Mr. Horst, one section thereof mapping out on the 1-inch scale the hilly native states north of the Nerbudda, and the other surveying on twice the scale the revenue-paying portions of the Khandesh plains on both sides of the Tapti.

An important survey has been brought to completion in Eastern India during the season under review. The Central Provinces and Vizagapatam Agency Survey was originally organised in 1844, from the Madras Survey, for the survey of Ganjam and Orissa, and has now completed an enormous area of country amounting to 72,144 square miles, extending over eight degrees of longitude, and embracing 170 sheets between the Nizam's territories and the Central Provinces on the west, and the Bay of Bengal on the east. The region to the north-west of the last-named party, a wild hilly and inaccessible country forming one of the chief water partings, or, as it might be termed, the backbone of India, was occupied by Colonel Depree's party, which has also arrived at the conclusion of its labours, after having surveyed in the course of 22 years all the Chota Nagpore division with its tributary states, and the north-east portion of

the Central Provinces, an aggregate of 51,805 square miles. This party has been now amalgamated with No. 7, which has still a very large tract of country to cope with in the western half of Rajputana.

The Khasi, Garo, and Naga Hills Survey has been again divided into three sections, under Major Badgley, in the vicinity of Shillong, under Lieut. Woodthorpe, to the south-east of Sadiya, on the upper Brahmaputra, and under two other assistants in the Khasi, Garo, and Kamrup districts. The difficulties encountered by these parties (particularly by the second one in its remote operations on the confines of Burma) were great, and the out-turn of work was small, but nevertheless satisfactory. An interesting description of the country traversed is given by Lieut. Woodthorpe and Mr. Ogle in the Appendix to the Report. General Thuillier estimated that there was about three years' more work to complete the survey of Assam, and, as this will include the accumulation of information regarding the trade routes between Assam, China, and Burma, he strongly urged its vigorous prosecution. It is stated, however, that it has since been discontinued.

Lieut. Leach in charge of No. 7 party was engaged on a large scale survey of Simla during the hot season, and on the Rajputana Survey in the field season. Lieut.-Colonel Depree will be the future chief of the party (consequent on the amalgamation of the Nos. 4 and 7), and he will proceed to complete the large remaining unsurveyed area, which is estimated to occupy about 12 years.

In Mysore survey operations were very much impeded by the famine, which has since led to the re-transfer of one of the two parties there employed to Head Quarters. This reduction will more than double the probable time of completion of the survey, which will thus take about 12 years more.

During the year under review Colonel Godwin Austen retired from the public service. This officer's name is well known in connexion with the survey of Kashmir under Major Montgomerie, where he completed much difficult surveying work amid the lofty mountains and enormous glaciers of Little Tibet and the neighbouring regions, with surveys in Bhutan (with Mr. Eden's mission, and during the ensuing military operations, 1863 and 1864), and in the Daphla expedition of 1875. The whole of the Khasi, Garo, Jaintia, and North Cachar Hill Districts, and a large portion of the Naga Hills and Manipur, Western Bhutan and the Daphla Hills were

surveyed under his superintendence. Colonel Godwin Austen during his long employment on the Survey made many valuable observations of the geology and zoology (especially ornithology) of the regions in which he served, which have enriched a variety of scientific periodicals.

Under General Thuillier's administration, first as Superintendent of Revenue Surveys, and next as Surveyor-General, the total out-turn surveyed by Topographical, Revenue, and Cadastral Survey parties, on scales varying between 1 and 32 inches to the mile, has been 796,928 square miles, or more than one-half of British India. In the Engraving Branch it is noticeable that since the transfer of the engraving work to India in December 1868, 50 new quarter plates have been completed, and 26 new quarter plates of the Indian Atlas have been taken in hand, besides 18 old ones revised. The quality of the engraving of more recent plates is in some cases excellent, and bears favourable comparison with the best English work.

It may not be inappropriate here to glance at General Thuillier's career in India. He entered the service in 1832, and succeeded Colonel Wroughton as Superintendent of Revenue Surveys in 1847. In 1851 he published (with the assistance of Captain R. Smyth) the "Manual of Surveying for India," a valuable work, and the official text book for Indian surveying officers. A new edition of this book revised and brought up to date was brought out by Colonel Thuillier two years ago. In 1861 he was made Surveyor-General of India, which appointment he has, like the late Sir Andrew Waugh, held for just 17 years. He has thus been connected with the Survey Department for over 35 years. The great area of country surveyed and mapped out during his administration is a noble monument to the success of his labours. The Secretary of State for India expressed himself regarding General Thuillier to the following effect, in a Despatch to the Governor-General of India :—

"During a service in the Department of more than 41 years, General Thuillier has devoted himself with energy and perseverance, of which it is difficult to speak too highly, to the task of securing an accurate survey of British India, and the results attained under his personal superintendence, amounting as they do to more than half the total area of the entire country, are such as to merit my hearty congratulations."

The areas still remaining for topographical survey are as follows:—

	Square miles.
Gwalior and Central India	7,000
Khandesh	4,800
Bhopal and Malwa	9,000
N.E. Frontier and Naga Hills	10,000
Rajputana	54,500
Mysore	22,000
Kattywar	4,300
Guzerat	25,800

Of late the question has been often asked, When will the whole of the survey of British India be completed? It is to be observed that not only do the unmapped regions require to be surveyed, but that the development of the economic wealth of the country, and the increased value of land render necessary larger, more detailed, and more accurate surveys of tracts which, in the first instance, were but roughly plotted out. The urgent demand on financial grounds for large scale cadastral surveys in the permanently settled districts of the N.W. Provinces points to the adoption of the same measures for the whole of Bengal and Behar, a question of considerable importance, and one which shows that the Survey Department of India has still a long career of usefulness before it.

IV.

Revenue Surveys of India, 1876-77.

Eleven Revenue Survey parties were at work during the year 1876-77, being one less than in the previous year, No. 9 party formerly employed on the Azamgarh Cadastral Survey, having been told off for the task of revising the cadastral survey of Azamgarh, Agra, and Hamirpur. Two detachments were in addition employed on special work in Chota Nagpore, and Assam. The total out-turn of the year, omitting the Assam *lakhiraj* survey, is 12,544 square miles (as compared with 11,175 square miles surveyed the previous year), on scales ranging from 1 inch to 32 inches to the mile, the increase being under every scale of survey except the 16 inch

cadastral, in which case the reductions were due to the fact that No. 9 party were employed on revision instead of new work.

Colonel H. C. Johnstone, who for several years past has been engaged on revenue surveys in the districts in the north-west of the Punjab, during the year 1876–77 was surveying in the districts of Rawalpindi, Dera Ismail Khan, and Bannu, and completed an out-turn of over 2,000 square miles of detailed survey on the scale of 4 inches to the mile. This survey has been hitherto most creditably conducted, the out-turn being an increase over that of last season, and the cost per square mile having steadily declined from Rs. 59-5-6 in 1873–74 to Rs. 32-3-6 in 1876–77. The comparison of areas with those of the *thakbust* rendered by the settlement department continues to agree well. Colonel Johnstone's relations with the frontier tribes have always been of a friendly description, and although the survey was at first positively objected to by them, his tact enabled him to overcome their scruples in the end. Some idea of the number of passes leading from the highlands of Afghanistan and Baluchistan into British India may be formed, when we learn that in the Dera Ismail Khan district alone the number of the principal passes leading into the hills to the west is thirteen, of which the Gumal and Tank passes are the most important, the former being plentifully supplied with water, extending almost up to Candahar, and being the great highway of the *kafilahs* proceeding thence to Hindostan. Details regarding these passes will be found in the elaborate maps of the Bannu, Dera Ismail Khan, and Dera Ghazi Khan districts prepared in the Surveyor General's Office. The survey of Rohtak and Sirsa districts was conducted by Captain E. H. Steel, and that of the former completed during the season under review; that of Sirsa will be probably completed in April 1879.

The N.W. Provinces cadastral surveys on the scale of 16 inches to the mile progressed in the Moradabad, Budaun, Muttra, and Banda districts, in the first two under Captain Barron, and in the latter under Colonel F. C. Anderson. The general average rate per acre for these cadastral surveys had been gradually and partly uniformly decreasing since their institution in 1871 down to four annas in the year 1875–76. The cost of survey in the Banda district during 1876–77 has been 4 annas 4 pies, a slight increase over this average.

In Agra, Hamirpur and Azamgarh, Captain Andrew has been engaged on the difficult task of revising the cadastral surveys, both by checking the work in the field and in the office.

The total out-turn of the Eastern Soane Irrigation Survey (32 inches to the mile) was 376 odd square miles, exclusive of part of the Soane River. The size of the fields was very small, averaging from one to three twentieths of an acre in area. On completion of the past season's work Mr. Johnson was transferred to take up the cadastral survey of the Jaunpur district of the North-West Provinces, but a portion of his party stayed behind to complete the Patna District Survey. A survey of the same scale (32 inches to the mile) has progressed in the Khurdah estate in the Pooree district, but at the high cost of 14 annas 9 pies per acre, a rate said to be due to the minute scale of the fields, and the difficulty in getting the Ooriyas to officiate as Amins. The Western Soane Irrigation Survey under Major Sconce was extended over 355 square miles at an average cost of 7 annas 5 pies per acre. The reproduction of these sheets formed a specially heavy undertaking, and arrangements have consequently been made with a Calcutta firm for the job, towards which the Bengal Government have made a grant of 3,000*l*.. The area allotted to this party has been reduced, so that the efficient establishment will be available for work elsewhere after next October.

The 12th or Midnapur District Survey under Mr. W. Lane, and (subsequently) Captain Wilkins, completed an out-turn of 1,554 square miles on the 4 and 1-inch scale. The comparison of the village boundaries with the thakbust maps supplied by the Settlement Department was not satisfactory; the revisions were very numerous, and in a very many cases the thakbusts did not agree one with another. The area remaining to be surveyed amounts to only 43 square miles, which was to have been completed early this year. The whole party has been, under Captain Andrews, transferred to the District of Cuttack, where it will take up the cadastral survey of the irrigable area amounting to about 362 square miles.

The Dearah or alluvial lands survey in the districts of Fureedpore and Backergunge covered an area of 952 square miles surveyed on the 4-inch scale, near the estuary of the Megna River, the scene of the disastrous cyclone wave of 1876. Of the Dhanwar and

Chota Nagpore estates, surveys on the 16-inch scale were carried on. The former, begun in the previous season, was completed during the season under review, but in both cases much difficulty and delay arose from defective demarcation, which, as Major-General Vanrenen points out, should in every case precede survey.

In the Bombay Presidency the total area rendered by the 10th or Nasik, Poona and Ahmadnagar district party, under Major Macdonald, amounted to 2,202 square miles on the 2-inch scale, an out-turn described as excellent, and accomplished at the rate of Rs. 26-4 per square mile on completed work, being less by Rs. 2-15 than the previous season's average. No details at all were taken from the settlement maps, the revision survey not having been carried over the tract referred to, and the only existing maps being from 25 to 30 years old. To the east the part surveyed was flat and open, but a good deal broken up in parts, and intersected by a net work of large and small streams. The country on the west is broken, undulating, and in parts hilly; in the vicinity of the Ghats it is a mass of hills, some of them very rugged and precipitous. On account of the severity of the famine the eleventh (Poona and Sattara) party was transferred to other districts, and 1,870 square miles of topography were completed in ground of a more hilly description. Little use was made of the Bombay Revenue Survey maps, the operations being chiefly carried on in the hills, but Major Tanner expects to have a number of very good maps available for next season's work. A lakhiraj survey was at work in Assam, on behalf of the Assam Settlement establishments.

An important reduction of scale has been ordered by the Government of India to be carried out in the case of future non-cadastral surveys in the North-West Provinces. Hitherto the practice has been to survey, on the 4-inch scale, those districts in the North-West Provinces, in which no 16-inch cadastral surveys were to be instituted. The object of this was to provide a survey large enough to admit of the muzawar or village-by-village definition, the standard unit which has hitherto been carried out in all its integrity in every province and presidency from the Indus to the Brahmaputra. It was also intended as a check on the native *Khasrah* or basis of the settlement operations, though the Government of the North-West Province had carried out a new and revised settlement without

its assistance, a proceeding which might, it was feared, cause loss to the Government revenue.

The Government, however, were of opinion that in these districts where settlement had long since been brought to a close, and the Khasrah Survey carried over the whole district, it would be unnecessary to effect a professional survey on the 4-inch scale showing details of cultivation, fallow and waste, and that all that would be required in such cases, would be a 2-inch survey on the topographical scale on which the village boundaries might be shown.* A report on the effect of these orders, on the time which the work will probably take to do and its cost, will be eventually submitted.

There is a good deal of cadastral survey work remaining to be done in the districts where the various parties are still engaged, and assuming them to work at their present strength they will be occupied thus:—

	Years' work.
Banda - - - -	2
Mirzapur - - - -	2 to 3
Jaunpur - - - -	5
Kurdah - - - -	5
Cuttack - - - -	2
Chota Nagpur - - -	5
Soane Irrigation - - -	1

Two of these parties may not improbably be transferred to Burma, where there is many years' work. The Moradabad cadastral and the Budaun 4-inch surveys are now being completed, and a proposal has been made to transfer the party employed thereon to Ghazipur, where there is five years' work.

Of Revenue 4-inch survey there is four years' work to be done in the Trans-Indus and Rawal Pindi districts, and five in the Sirsa and Hissar districts, while of Revenue 2-inch topographical survey the two parties in the Bombay Presidency have in their present districts (Nasik, Ahmednagar, Sattara, and Poona) sufficient work to occupy them for the next three or four years. There are 16 districts in the North-West Provinces, of which the maps and

* Letters from the Officiating Secretary to the Government of India, Nos. 679 and 23, dated 10th November 1877 and 15th January 1878. Proceedings, Surveys, (Revenue, Agriculture, and Commerce).

records were destroyed during the mutiny, and of which a re-survey is required for topographical purposes on the 2-inch scale. This work was commenced by one party last year, and a second will probably be employed on it next year. The aggregate area to be completed is 33,600 square miles, and the annual out-turn of work of a single party being about 1,400 square miles, there is about 12 years' work for two parties.

The Bombay Revenue Surveys are conducted entirely under the Settlement Department, and are not intended to supply maps for purposes of general administration, their object being simply to afford the requisite basis of information to assist the Government in determining the amount of land revenue to be paid by the cultivator.* Although the object and operation of these surveys are somewhat different from those hitherto mentioned, the present abstract would be incomplete without some reference to them.

During the year ended 31st October 1877, nine Bombay Revenue Survey and Settlement establishments (or one in excess of the previous year) were employed in measuring work alone, the majority of them being engaged in the Western Districts of the Dharwar Collectorate and in Kanara. In these districts rice cultivation prevails to a very large extent, the dry crop holdings are as a rule small, with very irregular boundaries, and the country is also much cut up with hills and streams, all of which makes measuring a matter of difficulty. The total number of acres measured was 643,856, being a decrease amounting to 160,700 acres as compared with the work of the previous season, attributable to the difficulties referred to. The quantity of "classing" executed (this being the process of determining the exact class in which the land should be ranked in respect of its degree of productiveness and general value, and the amount to be contributed by it to Government) was 497,384 acres as against 967,796 acres executed during the previous season with a somewhat larger establishment. The total cost of the survey during the season under review was Rs. 194,104 or about 19,410*l.*, as against Rs. 218,883 or 21,888*l.* the previous year, the decrease being

* A concise, but tolerably exhaustive, account of the method of measuring and classing in the Bombay Revenue Surveys will be found at page 193 of the second edition of the "Memoirs on the Indian Surveys."

principally caused by the transfer of officers and establishments to duty in connexion with the famine. A portion of the cost was defrayed from the revenues of the Kolhapur State, in which territory part of the survey progressed. The average cost of the survey per acre was 5 annas 2 pies, which was above the average of the last five years, viz., 3 annas 11 pies, the difference being caused by the smaller out-turn of classing and measuring.

In the Poona, Nasik, and Ahmednagar Collectorates four measuring establishments, under Colonel G. A. Laughton, were employed for the entire season, and one for a period of two months; the total out-turn being 340,447 acres as against 506,417 acres completed during the previous season. Besides the above a party was engaged throughout the season in erecting special boundary marks for the use of the Topographical Survey party.* Only one party was engaged in classing, and the out-turn rendered by it was 132,908 acres, being considerably less than the previous season, when there were two and a half parties at work. Between six and seven per cent. of the entire area was tested by European officers, and 22 of the Survey "numbers" were found to differ by more than 20 per cent. from the original measurements. The settlement was introduced into 221 Government villages in the Nasik and Ahmednagar Collectorates, and resulted in an increase of 7,582*l.*, or over 37 per cent. on the previous year's collections. The total cost of the department here was less than that of the preceding year, but the cost per acre was more than 30 per cent. higher, owing partly to the reduced establishments, and also to the minute sub-division of land in all the talukas bordering on the ghats, and the necessity of nearly all the establishments having to move twice during the working season from the plain to the hilly country.

In Guzerat, under Mr. N. B. Beyts, six parties were employed in measuring, classing, and city survey. One of these was engaged in the survey of the Dangs forest, a tract of which over 244 square miles, or fully one third have been already surveyed. The rate, which appears to be 74 Rs. 12 annas per square mile, is considered high, and the remainder of the operations will be conducted by the (late Trigonometrical) party under Colonel Haig. An area of

* *See* page 19.

95,371 acres was classed in the Panch Mehals and Ahmedabad and Surat Collectorates.

Mr. J. Gibson's parties, composing the Ratnagiri Survey, were engaged in the Collectorate of the same name, and in the Bhor and Sawant Wari States, in the duties of measuring and classing, the total area being 201,546 and 135,616 acres respectively, showing an increase in the former and a decrease in the latter as compared with the previous year's out-turn. The settlement was introduced into 22 villages in Tanna and Sawant Wari, the increase of revenue being over 38 per cent.

In the Hydrabad Collectorate in Sind, under Colonel M. R. Haig, five establishments were engaged on revision survey and two on classification. The revised settlement was introduced in the Sukkur and Sehwan talukas, the gain to the Government assessment far exceeding the amount expected by the Settlement officer. Settlement work is said to be much behind hand in Sind, and the revision remains to be carried out in twenty-one talukas of the Hydrabad and Shikarpur Collectorates, where the present settlements are no longer suited to the circumstances of the districts. The Government anticipate, however, that affairs will shortly improve, owing to the increase in strength recently given to the survey.

Taking the results for the year, there were 2,160,059 acres measured and 1,559,515 acres classed in the Northern and Southern Divisions of the Bombay Presidency, being a decrease of 299,202 and 536,143 acres in the two branches respectively. The cause of this was the serious famine of the year, which stopped measurements, classification, and introduction of fresh settlements, and caused many officers and men to be detached for famine duties.

The Madras Revenue Survey will be found described at page 188 of the Memoir on the Indian Surveys (2nd edition). The original scheme of survey has since been considerably extended, and, as now organised, is said to combine the operations of a revenue or cadastral survey with those of a perfect topographical survey on a trigonometrical basis. The revenue survey proper, with few exceptions, is confined to land paying revenue to Government on the ryotwary system. Lands held on other tenure, ranges of hills, and tracts of

waste land or forest of inferior value are excluded from this minute field survey, and topographically surveyed on a scale of two inches to a mile. The operations in Government lands are as follows:— The village boundaries are first settled, every turn of the line being marked with stone; then disputes are disposed of, irregular boundaries are adjusted, very small villages are amalgamated, and very large villages are sub-divided. After these preliminaries, the field boundaries are permanently marked with stone, and every holding is registered. Main circuits of from 50 to 100 square miles are carried out by the theodolite, the angles being checked by observations for azimuth at about every 50 stations. Village boundaries are also surveyed by theodolite, and check lines within the village, forming minor circuits of from 100 to 200 acres, are run. While the boundary work, which has been connected with the Great Trigonometrical Survey, is being plotted, the fields are measured by chain in triangles, so that when the measurement books are handed into the office, the map is ready to receive the fields. After correction or distribution of errors, the area of each field is computed by scale, and the sum of the areas so obtained is compared with the traverse area. The village map is then sent out for insertion of topographical details. In zemindary and hill tracts the details are put in by the plane table. The district and taluq maps are compiled in the Central Survey Office at Madras. Village maps are reproduced by lithography for the use of the Settlement Department. Taluq and district maps are also lithographed; photo-lithography has been in use in the Survey Office since 1873.

Up to the close of 1875–76 the area mapped, on the scale of 16 inches to the mile, in the Madras Presidency was 40,407 square miles, and 3,655 square miles are in course of survey. Topographical surveys, on the scale of 1, 2, and 4 inches to the mile, have been extended over 17,393 square miles, while 1,480 square miles are in course of survey, and 3,000 square miles are being surveyed by an Imperial survey party. The total number of village maps published is 13,420, while 75 taluq and seven district maps have been completed.

During 1875–76, revenue and topographical survey operations progressed in the Ganjam, Bellary, Cuddapah, North Arcot, Salem,

Coimbatore, Madura, Trichinopoly, and Godavari districts. Special surveys were also carried on in the Nilgiri Hills and in the Wynaad Taluq of the Malabar District. The total expenditure on survey, demarcation, and lithography, was 71,543*l.*

During the year 1876–77 six survey parties were employed in thirteen districts, and 967 square miles of field demarcation were completed, 1,637 square miles of field survey, 3,198 square miles of boundary demarcation, and 4,853 square miles of boundary survey, besides much miscellaneous work. There is a falling off in the out-turn of work in 1876–77 as compared with the previous year, but this is said to be in reality less than what it seems to be. Besides the field work a great deal was done in preparing village and other maps, and of the former class 4,714 square miles were mapped on the 16 and 4 inch scales.

The season was very unfavourable owing to the prevalence of famine, and many officers were detached for employment on famine relief duty. It is computed that there still remain 12,681 square miles of village survey, and 31,473 square miles of topographical survey to be completed before the entire Presidency is mapped out.

A scheme for the re-organisation of the department has been sanctioned by the Government of India, whereby the subordinate establishments hitherto distinctively employed on demarcation and field survey, will be amalgamated, and the salaries of the superior officers revised.

Little progress has as yet been made towards utilising the geographical materials collected by the Revenue Survey for maps of the country. The primary object of the department was to complete a revenue survey, and thus help to secure the benefits of a settlement of land assessment which should be based on accurate data, and this fact, coupled with the expense of the extra establishment which the compilation of maps would necessitate, caused the postponement of any measures towards that end. The Secretary of State, however, has drawn attention to the need of such maps, and in the scheme referred to an increment has been made to the Central Office grant, by which it may be possible to establish a small but distinct topographical and geographical section, and thus to ensure steady progress in reduction and compilation.

V.

Geological Survey of India, 1877.

The field work of the Geological Survey consists of two kinds; the preliminary examination of unknown ground, and the more detailed study of rocks, of which the general features have been already laid down. During 1877 two regions have been geologically explored for the first time, Kashmir and the upper basin of the Chenab, where Mr. Lydekker has been at work, and a wild hilly belt of country some 300 miles long between the Mahanadi and the lower reaches of the Godavari, which, although completely surveyed topographically, is one of the least frequented regions of India. Of Kashmir, Mr. Medlicott observes that hitherto flying observations had been recorded, and bold speculations based thereon, but Mr. Lydekker's observations, of which he gives a summary, are the first systematic ones recorded. Colonel MacMahon, an amateur geologist, has compiled a geological map of the Simla region, and has suggested an explanation of the disturbance of the strata, which Mr. Medlicott considers of possible great importance, especially with reference to the gneissic rocks, which he regards as the same as the central gneiss of the main range.

The other newly reclaimed area is between the Mahanadi and the lower course of the Godavari, a wild and hilly country, the topographical survey of which has just been completed, and which Mr. Ball has now examined from a geological point of view. Examples of "high level laterite" were found near and in the Eastern Ghâts, this being a level capping between 50 and 10 feet in thickness, which is found on most of the highest summits, whatever may be the structure of the under-lying rocks, and is still one of the greatest puzzles of Indian Geology. Mr. Hacket also traversed new ground in Rajputana, south of Ajmir.

Dr. Feistmantel and Mr. Hughes have been engaged in researches into the Indian coal measures, the former with regard to the palæontological features of those in the Damuda valley, and the latter between the Wardha valley and the Godavari in the Nizam's dominions, where coal out-crops have been actually found and will be worked. Both these investigations have in one sense formed part of examination of the Gondwana system, which has been further

elucidated by the work of Mr. King, below Sironcha in the Godavari basin, and Mr. Foote, up the course of the Krishna in the Nellore and Guntur districts.

In the Satpura basin four different series of borings for coal have been put down, one to the depth of 720 feet; but these have been attended with but little success, though Mr. Medlicott considers that at Mohpani on the Sitariva, where the only out-crop exists, much more might be done. Unfortunately the ground here is in private hands, and Government cannot interfere.

In Northern India, Mr. Wynne was occupied in mapping out the Potwar or Rawalpindi plateau, between the Salt Range and the mountains to the north, a region of complicated geological structure. The mapping of Sind west of the Indus was completed during the season by Messrs. W. T. Blanford and Fedden (the former of whom also explored the route to Sonmiani), and a valuable collection of organic remains has been got together in the the last two seasons.

During the year Vol. XIII. of the Memoirs, with views and coloured maps of the Rajmahal Hills, and Wardha Valley coal fields, was issued, and Vol. XIV. containing Mr. Wynne's description of the Salt Range was nearly completed, three fasciculi of the Palæontologia Indica were also published. The Manual of the Geology of India and the geological map of India are expected to be out very shortly.

As regards the future work of the department, the first labours will be to get a preliminary knowledge of the large area still remaining, in which no delineation of the geology, however roughly, has as yet been attempted. The largest of these blanks is the great area extending from Sirsa in the Punjab, to Guzerat; much of it is occupied by fossiliferous rocks that will demand close attention; but the preliminary boundaries might, in Mr. Medlicott's opinion, be traced in two or three seasons. In the adjoining area of the Trans-Indus Hills there is also a gap from Sind to Kohat; the accessible ground here is so narrow that one season might suffice to demarcate the leading features. There is still a large unknown area west of the Weinganga and Godavari, to map which, in the most general way, one season would hardly suffice. The remaining notable area is along the Malabar coast and round to Trichinopoli; stratified rocks are reported to overlie the gneiss in that position, but nothing

certain is known of their extent or age ; it would take two seasons to acquire a safe general knowledge of this tract. There are also certain areas, such as that of the Satpura coal basin, of the lower Narbada valley, and of the great coal basin of South Rewah, which, although marked in the index map to the annual report as "mapped, reported on, and published," require close examination. In the Himalayan region a good beginning has been made for future progress, and it is to be hoped that a few more years' work will disclose the simpler features of the ground to the north-west of the Chinese and Nepalese frontier. In the hills of Eastern Bengal and Assam much interesting work awaits the survey, but it is doubtful when it can be taken up.

VI.

Archæological Surveys.

The country hitherto explored by the Archæological Survey of India, under General Cunningham's direction, includes about two-thirds of the whole extent of Northern India, from the Indus to the mouths of the Ganges. Some portions of the Punjab and of Western Rajputana still remain to be examined as well as southern Oudh, and the whole of the country to the north of the Ganges and eastward of the Gandak River. The hill districts of Kumaon and Garhwal are also still unexplored. A large experience has convinced General Cunningham that many of the places which have already been visited will most probably yield fresh discoveries by excavation. Much difficulty has been experienced in getting information regarding the existence of antiquities owing to the combined ignorance and apathy of the people, so that the surveyors have often passed by unwittingly within a few miles of some interesting buildings or some valuable inscription. Making allowance for these drawbacks, however, it is probable that all the *principal* remains in about two-thirds of Northern India have been now examined, and that any future discoveries of importance will be due to excavation.

The last report received on General Cunningham's Archæological investigations was Volume V. of the series, giving an account of the interesting researches at Bharhut in the cold season of 1872 (see "Memoir," 2nd edition, p. 270). In the spring of the present year a statement was received showing the state of the

preparation of the various reports, and a brief account of the work of each of his assistants in each season since 1872-3. A similar brief annual report on the work done is to be submitted at the close of each working season.

During the cold season of 1873-4 General Cunningham paid a flying visit to Bharhut, where the sculptured railing of the Great Stûpa was discovered. He then examined the remains near Jubbulpore, and at Bhera Ghât made a plan of the curious circular colonnade with its 64 female statues, which Mr. Beglar photographed. Many interesting inscriptions of the powerful Kulâchuri dynasty of Chedi were obtained in this locality, and two important inscriptions of the Gupta period. At Khandwâ, Burhânpur, and Asirgarh General Cunningham obtained several inscriptions, and at Bhândak he explored and measured the Buddhist caves and rock houses and several Brahmanical temples. He then proceeded to Mârkandi on the Warda River, where he made plans of the fine group of temples, and copied all the inscriptions. From thence he returned to Bharhut, where he spent a considerable time in excavating the buried railing which once surrounded the Great Stûpa. He closed the season's work by a visit to Kosani (the ancient Kausâmbi), where he obtained a considerable number of terra-cotta figures with Buddhist symbols, including also several children's toy-carts in terra-cotta of the Gupta period. During the same season Mr. Beglar explored the eastern portion of the Central Provinces. He visited with General Cunningham the ruins of Tewar, Karanbel, and Bhera Ghât, and then diverged eastward to explore a variety of places, including the little known and almost inaccessible fort of Tipagarh, Rajam, where the remains are old and interesting, and Balod and Dhamtari, where he found some ancient temples, and two inscriptions of the powerful Chalukya family. Mr. Carlleyle's work during the season consisted in the exploration of a number of ancient sites in the districts of Agra, Aligarh, Etah, and Bulandshahr in the Gangetic Doab as well as many of the principal sites in Rohilkhand. Among the latter the most remarkable was the old city of Sambhal, where the Masjid of Baber was found to be an old Hindu temple altered and adapted to Muhammadan worship. In the Doab the old places were of comparatively little interest, excepting the great mound of Indorkhera, about seven miles from Anupshahr, near the road leading to Aligarh.

Here Mr. Carlleyle spent the whole of the hot weather and rains of 1874 and the greater part of the cold season of 1874-75, and made a thorough exploration of the mound, in which he was fortunate enough to find an inscribed copper plate, bearing the name of Skanda Gupta, with the written date of 146 Samvat, a discovery which disposed of the hitherto accepted reading of the Kakaon pillar inscription which was made to fix the death of Skanda Gupta in 141.

In 1874–75 General Cunningham returned to Bharhut to complete the excavation of the sculptured railing in company with Mr. Beglar, who was chiefly employed in making photogaphs of the sculptures. From Bharhut he proceeded to Mâlwa, in the vicinity of which he examined several ruins and found several valuable inscriptions. On his return he explored the great fortress of Singorgarh and the temples at Majholi and Bahuriband. Mr. Beglar spent the early part of the season at the Stûpa of Bharhut in making photographs of all the principal sculptures. He then proceeded into the Rewah territory to examine the ruins at Amarpâtan, Tâla, Mukundpur, and others, near the junction of the Saone and Banas rivers, including the unique solitary temple at Chandrebe. From thence he visited the ruins at Kakarsiba, the caves and ruins of Mara and remains at Udaypur or Rabkop, the capital of the small state of Udaipur in Chota Nagpore Division. The caves near Sirguja were then explored, and copies taken of the inscription known as *Sita likhni* or "Sita's writing." He then examined the ruins of Sambhalpur, and marching through the Saura-Malia States reached Gumsar and Ganjam, where he made photographs and impressions of the great inscription of Asoka engraved on the rock of the Jaugada Fort. From thence he visited the antiquities at Bhanpur, Chandeswar, and many other places near the Chilka Lake, finally closing work at Cuttack. Toward the end of the same season Mr. Carlleyle proceeded to North-eastern Oudh and Gorakhpur district to search for the site of Kapilavastu, the birthplace of Buddha. After a careful search he discovered the true site, afterwards visited by General Cunningham, at Bhuila (?) Tâl, 25 miles to the north-east of Fyzabad, and explored the whole neighbourhood, identifying many other places, such as the *Sarâ-kupa* or "Arrow well," where Buddha's arrow on striking the ground gave birth to a spring. The place still retains the name of Sar-Kua.

In 1875–76 General Cunningham began his tour under the Chunar Hills, and explored all the caves and other remains down to Saha-

sarâm, where he copied the newly discovered inscription of Asoka. He then proceeded to Bodh Gaya, where he made a survey of the country round the great temple. After inspecting Mr. Carlleyle's work General Cunningham went on to Srâvasti, where he made numerous excavations, bringing to light a large building at the northern end, which he believes to be the famous *Gandha-kuti*. A Stûpa also yielded a great seal with 18 lines of inscription. At Tandwa, his next station, he laid bare the exterior of the great brick Stûpa, which he has identified with the Mausoleum of Kâsyapa Muni, the third of the last four Buddhas. From thence he proceeded to Pakhna-Bihâr, near Sankisa, where he obtained a considerable number of old inscribed seals, including one with a representation of the three famous ladders by which Buddha descended from the heavens, accompanied by Brahma and Indra. He also got several terra-cotta figures of the Buddhist period, and an inscription of one of the Indo-Scythian kings, imperfect, but nevertheless of importance, as proving that their rule extended as far eastward as Sankisa, between Farukhabad and Mainpuri. At Sankisa he was fortunate enough to find the basement on which the great Asoka pillar with the elephant capital had originally stood, but he could not find any traces of the shaft of the pillar. Mr. Beglar's work during the same season lay at Bhitari (between Benares and Ghazipur) at Sahasarâm, where he made reproductions of the dated inscriptions of Asoka in the rock-cell of Chandan Shahed, and photographs and plans of the great rock tombs of Sher-Shah and his family. At the fort of Rohtâs, which was thoroughly explored, he discovered a large seal of Rajah Sasangka, the great opponent of Buddhism, shortly before A.D. 600. The letters are sunk in the rock in reverse. He also visited numerous other ruins, caves, old forts, &c., and secured a copious collection of photographs, plans, &c.

In 1876–77 General Cunningham found a fine statue of Buddha at Rhita, near Allahabad, with an inscription. At Tigowa he examined a very old temple which he had discovered two years before. It proved to belong to the Gupta period, and to be a very fine specimen of that early style of Indian architecture. From thence he visited the ruined city of Besnagar, situated at the confluence of the Betwa and Bes rivers, and made a complete survey of the place. Numerous remains of a very early date were brought to light, among which are a colossal female figure of the time of

Asoka, and several pillar capitals of the same date. Two are surmounted by lions, one by an elephant with rider, one by a crocodile, and one by the famous *kalpa-vriksh* or tree of plenty, which yielded to the fortunate possessor whatever he desired. The tree itself is represented as a banyan, with pendent roots, from which hang skins filled with wine, and vessels of various shapes overflowing with coins. At Deogurh, in Southern Bundelkhand, General Cunningham found a fine temple of the late Gupta period, ornamented with some large sculptures of unusual merit and beauty. During the same season Mr. Beglar accompanied General Cunningham for some time for the purpose of taking photographs of sculptures and architectural remains, chiefly of the Gupta period. At Bhita, south of the Jumna, several Buddhist sculptures were photographed, among which is a fine figure of Buddha, of the Gupta period, with the head-dress of a Tibetan Grand Lama. At Garhwa some very beautiful pillars and sculptures, also of the Gupta period, were discovered. He visited several ruins in North Bundelkhand, a curious old temple built of polished stones at Mokunddwâra in Rajputana, which he thinks to be the oldest structural temple yet found, as well as various other sites in Rajputana and Ajmere, and finished the season by taking photographs of the fine Asoka capital at Sankisa, of the inscribed pillars of Kumâra Gupta's temple at Bhilsan, and of the curious brick temple of Bhitargaon, with its carved and moulded ornaments and its terra-cotta *alti rilievi* 2½ feet in height. Mr. Carlleyle's work lay eastward of his previous season's operations, in the direction of Kasia, already identified with Kusinagara, the scene of Buddha's death. This identification has now been settled beyond all doubt by Mr. Carlleyle's discovery of the colossal statue, upwards of twenty feet in length, of Buddha lying dead with his face turned to the westward, and immediately to the west of a brick stûpa, exactly as described by the Chinese pilgrim Hwen-Thsang in the seventh century. Here also he discovered a long inscription on a stone slab with the opening invocation to Buddha. The mound about the stûpa was excavated, and revealed the fact that the great Nirvana statue had been enshrined in an arched chamber or temple as recorded by the Chinese pilgrim. This important site being thus fixed, Mr. Carlleyle proceeded to explore the whole neighbourhood, and he has been able to identify many other sites connected with memorable incidents in Buddha's lifetime. The

colossal Nirvana statue of Buddha bears an inscription on its pedestal in characters of the Gupta period. There can be no doubt, therefore, that this is the identical statue seen and worshipped by both of the Chinese pilgrims, by Fa Hian in the beginning of the fifth century, and by Hwen Thsang in the first half of the seventh century.

Volumes I., II., III., IV., and V., of the reports of the Archæological Survey of India have been noticed in the "Memoir on the Indian Surveys," 2nd edition, p. 270. During the current year the sixth volume has been received. It consists of a "Report, illustrated by "24 plates, of a tour in Eastern Rajputana, in 1871–72 and 1872–73, "by Mr. A. C. L. Carlleyle, Assistant to General Cunningham." Mr. Carlleyle prefixes to the account of his travels a brief notice of the chief mountain ranges of Rajputana, the Pathar, Karkota, and Aravalli ranges. Of the Pathar chain he observes that the great hill range, of which it forms a part, is one of the most continuous and unbroken, and also one of the longest of hill ranges in India. It is about 200 miles long from south-west to north-east, and yet in maps generally it is laid down incorrectly and confounded with a totally different one, the Karkota range, about twenty miles further west. Mr. Carlleyle ascertained that southward the people call this range Araballa, and he therefore regards it as the true Aravalli range, instead of the one commonly so called which lies further west on the borders of the desert.

Mr. Carlleyle first visited several sites in the Fathipur Sikri range of hills to the west of Agra, where he discovered stone cairns, monoliths, and some colossal statues, the latter at Rûp-bâs. He next visited Baiâna, which before the time of the Lodis was a sort of secondary capital to Delhi, and the neighbouring hill fortress of Vijaymandar, where he found a *lât* or monolith of red sandstone, with an inscription dated in the Samvat year 428, (probably 506, A.D.). General Cunningham points out that this inscription, which is quite perfect and has been translated by Dr. G. Bühler, is of special value, as we have hitherto found but very few dated records of so early a period. Here also Mr. Carlleyle discovered a curious minar, apparently built in the time of Muhammad Shah bin Farid Shah of the Sayyid dynasty, who reigned between 839 and 847 A.H. The sides of the minar bulge outwardly with a gentle curve, and the upper storey is ornamented about the middle by a coloured band of

green and blue squares, probably glazed tiles, built into the structure. Its present height is 74 feet, and it is built of two storeys, but it had formerly a third storey, and in all probability was surmounted by a cupola pinnacle, and so must have been over 100 feet at its full height. He afterwards visited the ancient town of Mâchâri, where he discovered another original tomb, some dated inscriptions, and a sort of colonnade of sixteen pillars, with their shafts richly sculptured, principally with bands of floral devices of considerable elegance and variety. At Bairat Mr. Carlleyle discovered a rock inscription of Asoka. It was imperfect; but after some time General Cunningham found it was a third copy of the dated inscription of Asoka, of which two nearly perfect texts had been found at Rûpnâth and Sahasarâm. At Deosa (nearly due east of Jaypur) Mr. Carlleyle found several monoliths, which in most cases had been formerly disposed in circles, and were in his opinion the work of aborigines during the prehistoric period. At Thoda (about equidistant from Ajmir and Jaypur), the chief attraction is the great temple, with a plinth or basement elaborately sculptured, of which plans and drawings were made, and in a fine old temple at Visalpur, about seven miles off, Mr. Carlleyle found two dated inscriptions of Prithvi Raja, the earliest dated Samvat 1231. Nagar or Karkot Nagar, the next place of importance visited, is a very ancient place, founded, as it would appear, about 1350 B.C., and probably destroyed by some volcanic convulsion; about six thousand ancient coins were here picked up by Mr. Carlleyle and his servants, and the better specimens of these furnished the names of nearly forty different kings. As Buddhist symbols occur on many of these coins, it may be inferred that the ancient kings of Nagar were Buddhists from the time of Asoka up to the third century of the Christian era. The destruction of ancient Nagar probably occurred about the end of the fourth or the beginning of the fifth century of the Christian era. General Cunningham remarks of these coins that, as nearly the whole of them bear the name Mâlavâns, which he takes to refer to the Mâlavâns of the Hindu Purâns, and, as this name occurs in characters of all ages from the time of Asoka (250 B.C.) down to about 500 or 600 A.D., he concludes that the city must have flourished throughout the whole of this long period.

Tambavatè Nagari, lying about 11 miles N.E. of Chitor, is of special interest, as it is undoubtedly one of the oldest cities in

Northern India, and although known by repute to Colonel Tod, (author of the "Rajasthan," &c.), was searched for by him in vain. About 145 coins selected by Mr. Carlleyle, out of a larger number found here, have been ascribed by him to periods varying between 350 B.C. and the eighth century of the Christian era. A descriptive list of them finds place in Mr. Carlleyle's volume. He also visited Bijoli, the temples of which are of particular archæological interest, and returned to Agra early in 1873, having spent the greater part of the two cold seasons of 1871–2 and 1872–3, besides the whole of the intervening hot season and rains of 1872, in a prolonged and interesting tour in Rajputana.

The above are the general contents of volume VI. of the Archæological Survey of India.

The following volumes are in various stages of preparation:—

Volume VII. Mr. Beglar's Report on Bundelkhand for 1871–72, and his Report on the Central Provinces for 1873–74.

Volume VIII. Mr. Beglar's Report on the Lower Provinces of Bengal for 1872–73.

Volume IX. Mr. Carlleyle's Report on the Doab, Rohilkhand, and Bhuila Tâl (the ancient Kapilavastu) for 1873–74 and 1874–75.

Volume X. General Cunningham's Report on the Central Provinces and Malwa for 1873–4–5 and 1876–77.

Volume XI. Mr. Beglar's Report on the South-east Provinces for 1874–75 and 1875–76.

Volume XII. Mr. Carlleyle's Report on Kasia (the ancient Kusinagara) for 1875–76.

Volume XIII. General Cunningham's Reports on the Doab and Oudh for 1875–76 and 1876–77.

Volume XIX. Mr. Beglar's Report on Bundelkhand, Malwa, and Rajputana for 1876–77.

In addition to these General Cunningham has been engaged on the following separate publications:—

1. A collection of ancient Indian inscriptions, entitled *Corpus Inscriptionum Indicarum*. Of this Volume I., containing lithographs of Asoka's inscriptions, has been published. Vol. II. is proposed to contain the inscriptions of the Indo-Scythians, and Vol. III. the inscriptions of the Gupta dynasty.

2. A collection of specimens of ancient Indian architecture showing the various styles in use at different periods. A large collection of materials has been made for this subject as well as for the next, for the illustration of the Asoka, Indo-Scythian, and Gupta periods.
3. A collection of examples of early Indian sculpture.
4. A collection of specimens of Indian architectural ornament in mosaic, trellis, &c. A first volume of Indian mosaics, illustrated with coloured plates, has been completed, and a second volume containing plates of Indian trellis work, from the simple chequers of the old Hindu temples down to the elaborate and delicate tracery of the marble screen of the Tajmahal.
5. A collection of specimens of Mediæval Indian architecture (partly done).
6. A collection of specimens of Muhammadan architecture (nearly complete).

General Cunningham's most absorbing work, however, has been the compilation of an elaborate monograph, profusely illustrated with photographs and lithographs, on the Stûpa of Bharhut. This work, the illustrations of which are being produced by Messrs. Vincent Brooks, Day and Son, will consist of about 143 pages of letterpress, and photographic and other illustrations reproduced from some excellent negatives, &c. taken by Mr. Beglar. A brief account of the sculptures will be found in the "Abstract of Surveys, &c. for 1872–3."

In Western India Mr. J. Burgess's archæological researches, between November 1875 and May 1876, were of peculiar interest,* being conducted principally in the western part of the Nizam's dominions, a tract hitherto quite unknown to the antiquary. Tuljapur, the first place visited, stands on the borders of the Haidarabad territory, on the verge of the Bâla Ghât, one of the terraces by which the table land of the Dekhan descends westward. It contains a temple and buildings attached, but of no great importance. At Dharasimha, about 12 miles to the north, groups

* Archæological Survey of Western India, Vol. III. Report on the antiquities in the Bidar and Aurangabad districts in the territories of H. H. the Nizam of Haidarabad, 1875–76. By Jas. Burgess, F.R.G.S., M.R.A.S. London (Allen & Co., Trübner & Co., Whittingham, and Stanford). 1878.

of Jaina and (probably) Vaishnava temples were examined, and at Karusa some caves in a hill of laterite were surveyed, one called Mahadeva's being noticeable for a profusion of sculptured incidents in Hindu mythology, while at Nilangâ, south-east of Karusa, a Saiva temple, in what is called the Hemadpanti style, was the chief antiquity. Kalyâna, the next place of importance, was originally the capital of the Chalukya dynasty of the Dekhan, whose rule must have at times extended over a large area, then known as Kuntaladesa, stretching from the Nerbudda river on the north to about the Tungabhadra to the south, reaching to the Arabian Sea on the west, and to the Godavari river and eastern Ghâts on the north-east and south-east. In the southern portion of this area the Kannada or Canarese language is spoken. Mr. J. F. Fleet and Sir Walter Elliot have helped greatly to elucidate and extract from inscriptions the history of this dynasty; the latter has remarked that "it is the oldest race of which we find satisfactory mention "made in the records of the Dekhan, and it appears to have "belonged to the great tribe that under the general name of Raj-"puts, exercised dominion over the whole of Northern and Central "India." The two dynasties would appear to have flourished from about 465 A.D. to 1190. They were mostly devoted to Vishnu, but both Jainas and Saivas were protected and patronized, as is proved by their inscriptions. Kalyâna was doubtless in the middle ages adorned with many large and splendid temples and palaces, but in the struggles that succeeded the fall of the Chalukyas, and the frequent wars that for four hundred years devastated this part of the Dekhan, the Hindu buildings were ruthlessly destroyed, and the modern city is a purely Muhammadan town.

After visiting Nârâyanpur and Umnabad or Hominabad, Mr. Burgess went on to Bedar or Bidar, a large walled city on a high and healthy plateau 2,330 feet above the sea level, or fully 500 feet above Haidarabad. One of the principal edifices, the remains of which still exist, is the Madrasah or college, built in the latter half of the fifteenth century, and formerly containing a library of 3,000 volumes. There are several Muhammadan remains of considerable interest in Bidar, especially of the Bahmani and Berid Shahi dynasties, but they are falling rapidly into decay.

Between Bidar and Mominabad, a distance of one hundred miles, there was not much worthy of note, but at the latter town a number

of Brahmanical and Jaina cave temples were surveyed at the old town called Jogai Amba, and two inscriptions of the Yadava dynasty of Devagiri were discovered, one of which has been translated in full by Dr. Bühler. From thence the route lay through Mungi, in the British province of Ahmadnagar, to Paithan, probably the same place as the Παίθανα of the Greek writers and Pratishthana of the Hindus. The author of the "Periplus of the Ærythræan Sea" says abundance of onyx stones was brought thence, and this stone and the carnelian are still common in the neighbourhood, but not of fine quality. Here the great King Salivahana, who founded the Saka era, is said to have ruled in the first century. The town is beautifully situated on the left or north bank of the Godavari, and is looked upon by Hindus as a favourite resort of Brahma. Its architectural magnificence has long since disappeared, and even the manufacture of silk shawls, which were famous throughout India, has ceased to enrich the place, a ruinous tax having been imposed, which drove most of the weavers away and destroyed the principal source of trade. After visiting the Hindu sacred place at Sanvkhed, Mr. Burgess examined the very remarkable Buddhist rock-cut temples at Aurangabad, which have hitherto apparently attracted but little attention, though Dr. Bradley, in his account of the statistics of the Sarkar of Paithan, furnished a notice of them.

One of the caves (No. III.) is supported by columns of remarkable richness and elegance of detail, lithographed representation and detailed descriptions of which have been given by Mr. Burgess in his report. On an architrave a series of scenes of unknown interpretation, but evidently representing a history or a succession of incidents, is carved. The most striking peculiarity of this cave is a group of worshipping figures, occupying the front corners of the shrine. These have very thick projecting underlips, short chins, long straight noses, and an almost Egyptian cast of countenance, while their styles of head-dress are most varied and ornate. Another of the caves (No. VII.) contains on one side of the door of the shrine a gigantic figure representing the famous Avalokitesvara Bodhisattva, so often spoken of by the Chinese pilgrims, Fah-hian and Hwen Thsang, and identified also in Nepalese and Chinese mythology. He is always represented in Indian sculptures as holding a lotos stalk in one hand, with an opening bud, and generally with a rosary or

jewel in the other; his hair is abundant and falling in ringlets upon his shoulders, and on his forehead is a small figure of Amitabha, the lord of Sukhavati or the Western Happy Land and the fourth Dhyani Buddha. On each side of him are four scenes forming a sort of pictorial prayer or litany. On the other side of the door is another colossal Bodhisattva, probably Manjusri, distinguished for his merciful character.

Mr. Burgess remarks that, while the earlier favourite Buddha symbols, such as the tree of knowledge, the many hooded snake, the sacred wheel, &c., are not found in the later caves, the Bodhisattvas never occur in the earlier ones. This marked fact suggests that the myth respecting Amitâbha, his "Western Paradise," and his spiritual son Avalokitesvara was due to a foreign westerly element, and most probably a Christian one. It is not Hindu, yet it sprang up in Southern India and probably on the Malabar coast where Christianity first appeared in India. This seems suggestive of an early influence affecting Buddhism from a Christian source, whether directly missionary, or indirectly through Alexandrian merchants trading with Barugaza (Broach) and other parts on the west coast.

Elurâ, the last station visited, is noticeable for the temple of Ahalyabai (1765--1795), a good specimen of Hindu architecture, surmounted with a beautifully sculptured square pyramidal tower or *sikhar* rising in five tiers over the shrine. The survey of the famous and very extensive series of caves, Buddha, Brahmanical, and Jaina, at this place, was begun in 1876, and carried on during the greater part of the working season of 1876–77, when it was completed. But the account of them and of the other groups of cave temples is reserved for a special work now in active preparation by Mr. Burgess and Mr. J. Fergusson.

Mr. Burgess winds up his report with notes on a variety of inscriptions, some from the more northern districts, translated by Dr. Bühler, and twenty-eight from the Belgaûm and Kalâdgi districts, chiefly from his First Report, and now transliterated and translated by Mr. J. F. Fleet, Bo. C.S.

The subject of Indian inscriptions is closely connected with Indian archæological research, for by it the chronology and sequence of old dynasties, on which the history of the past is largely recorded, can be ascertained. Hindu literature scarcely supplies any works

of a historical character, and it is fortunate that this want is compensated for by many contemporary records in the shape of inscriptions, which really served as the title deeds of the grants and endowments made by kings and chiefs to temples and religious communities. Some of these inscriptions are on rocks, some on the pillars and walls of temples, others on large stone slabs set up in public places, and others engraved on plates of copper held together by rings, to which is attached the seal of the reigning dynasty. Sir Charles Wilkins, General John Carnac, Sir John Shore, and others, who rallied round Warren Hastings and Sir William Jones, some 90 years ago, to form the Asiatic Society of Bengal, fully recognised their historical importance, and began to collect and investigate the contents of inscriptions. During the first years of the century Colonel Colin Mackenzie is said to have prepared copies of 8,076 inscriptions in Southern India altogether. These however, have never been properly deciphered, and the original copies have lain for many years in the India Office archives. Buchanan-Hamilton also collected many inscriptions, of the value of which nothing is known. During his long residence in India Sir Walter Elliot, K.C.S.I., spared no pains in collecting impressions of copper-plate grants and transcriptions of stone-tablet inscriptions, and by means of them was able to establish the chronology of the great Chalukya dynasty of the Canarese and Maratha countries (400-1100 A.D.), and other dynasties.

Early in 1851 the Bombay Cave Temple Commission called attention to the subject of inscriptions, and obtained the appointment of Lieut. Brett to copy and take impressions of them. Reduced copies of these lithographs, with the Rev. Dr. Stevenson's tentative translations, were published in the Journal of the Bombay Branch of the Royal Asiatic Society. A few years after, the same commission strongly recommended the publication of facsimiles of inscriptions with decipherments and translations, such a *corpus inscriptionum* being very important from an antiquarian and historical point of view. In accordance with their recommendation, Vishnu Sastri Bapat was appointed as pandit, and he copied and translated into Marathi some 88 Pali and Sanskrit inscriptions; but the death of the pandit ensued, and for the time nothing more was done.

About 15 years ago, however, Her Majesty's Government began to take a keener interest in such inquiries. In 1865 there were printed a few copies of a photographic collection of 149 inscriptions

on copper-plates and stone tablets at various places in the Mysore territory from negatives taken by Lieut.-Colonel Henry Dixon, and purchased by the Secretary of State. About the same time the Committee of Architectural Antiquities of Western India was formed, under whose auspices the Mr. T. C. Hope, of the Bombay Civil Service, edited and printed a collection of 64 inscriptions from stone tablets in temples and rocks in Canara, Bellari, and Mysore, the photographic negatives of which had been taken by the late Dr. Pigou and Colonel Biggs. These volumes probably helped to keep up the interest in the subject, and in 1870 the Duke of Argyll, then Secretary of State for India, forwarded to the Bombay Government a scheme for the collection and preservation of ancient Canarese inscriptions, suggesting that those collected by Sir Walter Elliot should be revised and compared with the originals, that any new ones should be added, and the entire series published. The difficulties of the work, however, prevented this scheme from being carried into effect. The starting of the "Indian Antiquary," in 1872, and the commencement of the Archæological Survey of Western India in 1874, helped materially towards the acquisition of perfect copies of inscriptions, and a yearly grant, made by the Secretary of State in Council to the first named publication, has been of immense service in enabling that journal to publish a large number of facsimiles of inscriptions, (including many of Sir Walter Elliot's), along with their transcriptions into modern characters, and translations.

Of the two above-mentioned collections, however, so few copies were available for reference, that the Secretary of State has sanctioned the printing of a new volume* composed of Colonel Dixon's, Colonel Biggs's, and Dr. Pigou's collections, supplemented by photographs and lithographs from estampages and rubbings made by the Archæological Survey of Western India and by Mr. Fleet, and by reproductions of copper-plate grants from various sources. The total number is 287. This collection does not embrace nearly the whole of the inscriptions from Western India and the Dekkan at present available. Sir Walter Elliot possesses a large series of copper-plate grants of the Vijayanagara and other dynasties, while others exist in other private hands both in India and Europe,

* Archæological Survey of Western India.—Pali, Sanskrit, and old Canarese inscriptions from the Bombay Presidency, and parts of the Madras Presidency, and Maisur. Arranged, &c., by Mr. J. F. Fleet, Bo., C.S. under the direction of Mr. J. Burgess, M.R.A.S., &c. London, 1878.

in the India Office Library, in the Royal Asiatic Society, in the Bombay Asiatic Society, and in the British Museum. Fresh inscriptions are also constantly being found and increasing the mass of those awaiting publication. These records contain such ample materials, available nowhere else, for elucidating the history, the religious and social life, the origin and growth of the alphabetical characters, and the development of the vernacular languages throughout India, that it appears desirable, at a time when Prussia and France are doing so much for Latin, Greek, and Semitic inscriptions, that some steps should be taken for promptly and systematically recording the fast disappearing Indian inscriptions.

The *Indian Antiquary*, referred to above, continues, with the help afforded to it by Government, to fully maintain its reputation of being the best means of making at once known all the most recent information on Indian archæology.

During the present year, Major Watson has published in it some fragments relating to Anandapura, in Saurachtra, in connexion with the question whether it is, or is not, the Anandapura of the Chinese pilgrim Hwen Thsang. The evidence is rather against the actual identity of the two towns, though the modern city may have been founded on the site of an ancient city of the same name. Sir Walter Elliot has furnished some interesting notes on a singular hypœthral temple in Orissa, which is evidently deserving of a minute examination and a detailed report, and has given an account of an edifice, formerly known as the Chinese or Jain pagoda, at Negapatam.

Mr. Fleet's series of Sanskrit and old Canarese inscriptions embraces grants of the Eastern and Western Chalukya, the Kadamba, the Ganga, and the Sendra dynasties, with incidental disquisitions, the importance of which will be recognised when the time comes for piecing together the ancient history of the south and west of India. By no means the least important of his papers are those which give in detail the two forged grants of the Western Chalukya kings, Pulikesi I. and Vikramaditya I., and these expose the two errors which have led to so much confusion in the early chronology of this dynasty.

Dr. Burnell has given a valuable contribution on the locality of the Southern Charitrapura of Hwen Thsang. There appears to be

little doubt that he is correct in identifying it with the once famous port of Kaveripattana, the *Chaberis emporium* of Ptolemy.

Some further important grants of the Gurjara and Valabhi dynasties are given by Dr. Bühler, who also indicates reasons for doubting the accuracy of referring the dates of the Valabhi plates to the Gupta era, commencing in A.D. 319, and enunciates his own opinion that the initial date of the era of the plates must fall either shortly before or shortly after A.D. 200. Further researches may probably justify this opinion, but may at the same time render it necessary to carry back the initial date of the Gupta era to the same epoch, and thus to make the Gupta and the Valabhi eras still identical, as they are now held to be, though they will both start from an earlier initial date than is now allotted to them, chiefly on numismatical grounds. At p. 141, Vol. VII., of the "Antiquary," Dr. Bühler has given further notice of the three new edicts of Asoka, published by him at Vol. VI., p. 149. The historical value of these new edicts lies in the facts that, 1., they fix absolutely the length of time which elapsed between Buddha's *nirvana* and Asoka; 2., they prove the accuracy of the chronology of the southern Buddhists, as far as India is concerned; 3., their *data*, together with the information of the Greek historians, prove the *nirvana* of Buddha to have taken place between B.C. 483–2 and 472–1; and, 4., they indicate the direction in which future efforts to fix the exact date of Buddha's *nirvana* should be made.

Some interesting Hindu and Jain remains at the ruined capital of Bijapur and in its neighbourhood are noticed by Mr. Sinclair at p. 121.

At p. 168, Mr. Rice has published two new grants of the Ganga kings, the dates of which are interpreted by him as A.D. 350 and A.D. 481 respectively. The real era of these kings is as yet very doubtful, inasmuch as Mr. Fleet's stone tablet inscriptions at p. 101–112, make them several centuries later than the copper-plate grants given here and elsewhere by Mr. Rice.

The Editor, at p. 196, has given a valuable contribution in translating, from M. Stanislas Julien's French work, Hwen Thsang's account of Harshavardhana. The want of a carefully revised and annotated translation, this time in English, of the Chinese pilgrim's works has been much felt for a long time past; there are hopes that it will shortly be supplied.

VII.

Indian Meteorology, 1876.

The second Annual Report by Mr. H. T. Blanford, Meteorological Reporter to the Government of India on the meteorology of India, being that dealing with the observations recorded in 1876, was published in the early part of the present year at Calcutta. It deals with a somewhat more extensive area than the preceding report. In India proper, indeed, the system is still incomplete. Five or six additional stations began work during the year under review, but the greater part of Western India was but little better represented than in the preceding year. But to the eastward, two new observatories at Rangoon and Moulmein extend the area of discussion to Pegu and Tenasserim, and bring into view, for the first time, the distribution of temperature and pressure far down on the eastern margin of the Bay of Bengal; while away to the west the establishment of an observatory at Bushire, at the head of the Persian Gulf, supplies a link in the connection of the Indian system of registration with that of Europe and Western Asia. During the year 1877 additional observatories have been started at Bassein in Pegu, Mergui in Tenasserim, and Quetta in Baluchistan. Most of the new stations in Bombay, Central India, and Rajputana will also contribute registers for 1877. In India additional registers for 1876 are furnished at Peshawar, in the extreme north-west of the British possessions and at Sirsa on the northern margin of the western desert; at Mount Abu, at a height of about 4,000 feet on the southern confines of the same; at Bhuj in Cutch, at Sutna, half way between Allahabad and Jubbulpore, linking the Gangetic plain with the more elevated tract forming the Central Provinces; at Sironcha on the Godavari, which, through Secunderabad, helps to connect the latter region with the Madras system, and to push the network of stations one step further into the wild and unrepresented country about the Lower Godavari. The number of rainfall stations has been much increased, 28 additional having been started in the Madras Presidency, and 43 additional in the North-west Provinces, the Central Provinces, and Berar. Rajputana, with Central India, and British Burma are still imperfectly represented, but Mr. Blanford hopes to remedy this

shortly. He regrets this inability to obtain more data regarding the average values of the chief meteorological elements in the Madras stations, the tables for which are very deficient, although the meteorology of that presidency is invested with exceptional importance in the light of the recent disastrous famines.

It is the great failure of the rainfall which lends special interest to the meteorology of the year 1876, and the analysis of this phenomenon Mr. Blanford has kept steadily in view in his report. Mr. Meldrum's researches, it is known, have drawn attention to the apparent cyclical variation of rainfall, and its coincidence in a greater or less degree with the cyclical variation in the number of sun spots. While acknowledging the persistence of this phenomenon, Mr. Blanford shows, that according to Mr. Meldrum's own researches, the total cyclical variation in the course of two cycles does not exceed 15 per cent. of the whole, and that to that extent *only* are we justified by proof in regarding the rainfall of India as a recurrent phenomenon. The great fluctuations, alternately productive of flood or famine, are therefore mainly non-periodic and local. Thus in 1877, there has been an almost complete failure of the summer monsoon rainfall in the Upper Gangetic valley, and a large part of Central India, Rajputana, &c., while the rain withheld from these provinces was poured out over the Bay of Bengal and the Burmese peninsula, and while the cultivator of Upper India has watched his weakly sprouted *sorghum* withering to hay under the unclouded sun and the dry hot blast from the western desert, his Burman brother has seen his vigorous rice crops washed away and drowned beneath the wide spreading floods of the overcharged Irawadi.

The discussion of the results for 1876, with the averages deduced from previous registers, and the tabulation of the several anomalies, month by month, confirm the idea that abnormal as well as normal conditions are remarkably persistent in India. The failure of the rainfall in the peninsula, and its deficiency in the Upper Gangetic Provinces are traceable to the remarkable persistency of northerly or land winds, which again are evidently connected with certain anomalies in the distribution of the pressure, which were manifested in the previous year but were more intense in 1876, and presented some new and probably important features.

The meteorology of the year is described under the following *headings*:—(i.) Temperature of solar radiation; (ii.) Temperature of nocturnal radiation; (iii.) Air temperature; (iv.) Atmospheric pressure; (v.) Anemometry; (vi.) Hygrometry; (vii.) Cloud proportion; and (viii.) Rainfall.

As already remarked, the most important and striking fact in the meteorology of 1876 was the failure of the rainfall in the Presidencies of Madras and Bombay, and its partial failure in a large portion of the North-west Provinces, more especially the Gangetic plain north of the river, and in some parts of the Central Provinces.

In Madras, with the exception of the low country below the Western Ghats, the failure was almost universal, while on the other hand, the extreme western and northern districts of the Bombay Presidency, where the rainfall is as a rule precarious and uncertain, did not participate in the general calamity. In Sind, indeed, the rainfall was somewhat in excess of the average amount, and along the extreme north of the Punjab, both on the Himalaya and at stations along the foot of the hills, the fall was considerably greater than usual. At Darjeeling, it was somewhat greater, but over the districts at the foot of the Sikkim Himalaya, and on the low valley of Assam there was a considerable deficiency. It was limited, however, to these tracts, since the Gangetic delta, Silhet, and the south-east of the Bay of Bengal received an excessive supply, the latter especially in the last three months of the year, when the south-west current, influenced by the rise of pressure over Northern India, recurves cyclonically around the Bay of Bengal, and discharges its burden of vapour on the south-east coast of the peninsula. In 1876 the rainy monsoon of the Carnatic failed almost completely, but only on the Madras coast. On the east coast of Ceylon, which also participates in the rains of that season, the fall was on the whole an average one.

These facts show, in Mr. Blanford's opinion, that the failure of the rainfall was essentially a local phenomenon, affecting indeed a large part of India, but not universal, and compensated by an increased fall around the borders of the area. It may be inferred from the researches of Mr. Meldrum, that 1876 was a year of less than the average rainfall, since it was a year of few sun spots, and, as referred to above, his statistics collected from large areas, both in the northern and southern hemispheres, tend to show that, in the

first or second year following that of maximum sun spots, the total precipitation is about 8 per cent. above, and, in one or two years in anticipation of the minimum period, 7 per cent. below the average. To this extent, and no more, Mr. Blanford points out, can our present knowledge justify us in attributing the deficiency or excess of rainfall in any part of the world to the immediate influence of the corresponding cyclical variations in the condition of the sun. Possibly, in some portions of the earth's surface local geographical peculiarities may serve to exaggerate, diminish, or even reverse these effects, but at present this is mere surmise.

The first striking peculiarity in 1876 is the apparently unusual prevalence of northerly and north-westerly winds in the Central Provinces and Berar, and of westerly winds in the Upper Gangetic Provinces. For years previous to 1875 there are unfortunately no data available, but, as compared with that year, the northerly tendency of the winds on the Dekkan plateau was very characteristic and probably abnormal, and equally so was the prevalence of north-westerly winds in the eastern part of the peninsula in October and November, when, as a rule, east and north-east winds bring the monsoon rainfall of the Carnatic. Hence it may be asserted in general terms that the land winds, varying in direction according to the locality, predominated throughout the greater part of the year, and that the replacement of the usual sea winds by these outflowing dry currents from Upper India and the interior, may be assigned with most probability as the proximate cause of the failure of the peninsula rainfall.

Proceeding a step further, Mr. Blanford shows that the relatively high pressure at Bombay, combined with the low pressure of Orissa, must have tended to impress a northerly or north-westerly direction on the movement of the air in Berar and the Central Provinces, while the depression about Benares and Patna, with a relatively high pressure to the westward, would intensify the north-west winds of the Upper Provinces and the westerly winds to the south of the Ganges. Taken together with the Orissa depression to the south-east, the excess about Chittagong would increase the strength of the southerly current from the bay across Bengal, which would then turn and blow along the mountains as a south-east and east wind to the northern side of the Gangetic plain, accounting for the excessive precipitation in that quarter above referred to. This rain on the

outer hills is generally accompanied by snow on the main and higher ranges, and the snow of the early spring of 1877 appears to have been considerable and late.

To this unusually late and copious fall of rain and snow on the Punjab and the North-west Himalaya may, in Mr. Blanford's opinion, be ascribed the comparative dryness of the Upper Provinces and the plateau south of the Ganges, but he considers there were doubtless other, and probably independent causes, which contributed to the general result, more especially as regards Southern India, and for the elucidation of these we must look forward to the gradual development of the *rationale* of meteorological processes.

Mr. Douglas Archibald, of the Bengal Educational Department, and Mr. S. A. Hill, the Meteorological Reporter of the North-west Provinces, have suggested that in years of minimum sun spots the winter rains of Upper India are more copious than in years of maximum sun spots, thus reversing for that tract and season the law of total annual rainfall arrived at by Mr. Meldrum. For this theory there is *primâ facie* evidence apparently borne out by the fact that some of the most severe famines of Northern India, *e.g.*, those of 1837–38 and 1861, have occurred immediately after years of maximum sun spots.

During the present year, Part II. of the first volume of the *Indian Meteorological Memoirs* was issued. It contains three papers; the first (No. IV.) by Mr. J. Elliot, M.A., Meteorological Reporter to the Government of Bengal on Storms in Bengal during the year 1876, accompanied with increased atmospheric pressure and the apparent reversal of the normal diurnal oscillation; the second by Mr. S. A. Hill, B.Sc., Meteorological Reporter to the Government of the North-western Provinces and Oudh, on the rainfall of Benares considered in relation to the prevailing winds; and the third by Mr. H. F. Blanford, on the diurnal variation of the barometer at the Indian stations.

During the present year, an important work by Mr. Charles Chambers, F.R.S., Superintendent of the Colaba Observatory, Bombay, has been published in England, by order of the Secretary of State for India. Its title is "The Meteorology of the Bombay Presidency;" it is divided into four parts, with an Appendix, and

is accompanied by a portfolio of charts and diagrams. The first part gives a very brief sketch of the history and character of the Colaba Observatory, an account of the records, and an examination of the results educed from the observations, both as to the typical character of the climate of Bombay and its periodical variations.

Colaba Observatory is situated at the extremity of a narrow strip of land extending two miles to the south-west of the Fort of Bombay. The main building was designed for an astronomical observatory and was erected in 1826, but the scheme fell through.

No meteorological observations taken at the Observatory are on record till the year 1841, when, on the recommendation of the Royal Society, the Observatory became associated in the prosecution of magnetical and meteorological research with the British colonial observations of Toronto, St. Helena, the Cape of Good Hope, and Hobarton, and with the Indian Government observatories of Madras, Singapore, and Simla. Its active life must be reckoned from this date. Its first director was Mr. Arthur B. Orlebar, Professor of Astronomy and Mathematics in the Elphinstone College, who appears to have displayed great judgment in the conduct of the magnetic and meteorological observations.

The discussion of all the phenomena, except rainfall, have been confined to the manuscript abstracts of the years 1844 and 1847 to 1872. These comprise observations of the barometer, dry and wet bulb thermometers, the degree of cloudiness, temperature of the ground, rainfall, and direction and movement of the wind. These are followed by a brief chapter on the comparison of the diurnal variations of different phenomena.

Part II. of the work deals with the observations at the five (so-called) military stations in the Bombay Presidency, and the observations there recorded. These observatories were organised in consequence of a representation made to the Court of Directors of the East India Company by the Imperial Government, who in 1851 had instituted a system of meteorological observations at a number of military stations in the United Kingdom and in the Colonies, which were supplemented by others carried on on the same system at other stations under the Admiralty. Of the five observatories in the Bombay Presidency, four—at Belgaum, Poona, Deesa, and Karachi, were in charge of the senior medical officers of

the European hospitals at the several stations, and one, at Bombay (Colaba), in charge of the Superintendent of the Colaba Observatory, and all five were kept up till the end of March 1876, when they were merged in the general organisation of meteorological observations instituted by the Government of India. The system comprised two sets of observations every day at 9.30 a.m. and 3.30 p.m., and a complete set of 24 hourly observations for one day in every month, comprising observations on the barometer, dry and wet bulb thermometers, direction of wind, cloudiness, and rainfall. Once a day the maximum and minimum thermometers were exposed. With certain exceptions (the most numerous of which are in the case of the Belgaum, Deesa, and Kurrachee observations) the series is available for 17 years—from 1856 to 1872.

Part III. contains a disquisition on the temperature of the Presidency, based upon the records of temperature at Colaba and the four military stations, and at a small number of other stations, the printed sheets of observations of the Goa Observatory, the Report of Mr. James Glaisher "On the Meteorology of India," and the fourth or meteorological volume of the Messrs. De Schlagintweit's India and High Asia. In the concluding Part (No. IV.) an effort is made to connect together some of the general phenomenal results that have been arrived at.

VIII.

Statistical Survey and Imperial Gazetteer of India.

The operations connected with the Imperial Gazetteer of India range themselves under two heads: the Statistical Survey of India carried out, district by district, with a view to the collection of local materials, and the Imperial Gazetteer, in which those materials are condensed into a concise alphabetical form. In the second edition of the *Memoir on the Indian Surveys*, an account was given of the progress of the first of these two operations up to the 31st of May 1876. It is unnecessary therefore to do much more here than review the progress which has since been made. On the 31st May 1878 the state of publication of the results of the Statistical Survey was as represented in the following statement.

Province.	Area in Square Miles.	Population.	Number of Districts compiled May 1878.	Number of Vols. and Pages printed.				Districts remaining to be compiled 31st May 1878.	Name of Provincial Compiler.
				May 1876.		May 1878.			
				Vols.	Pages.	Vols.	Pages.		
1. Bengal - -	196,942	62,815,370	47	13	5,578	20	8,246	Nil	W. W. Hunter.
2. Assam - -	53,856	4,132,019	13	Nil	Nil	2	917	Nil	W. W. Hunter.
3. North-west Provinces	86,528	31,438,217	35	4	2,840	5	3,340	20	E. T. Atkinson. A. C. Tupp. H. C. Conybeare.
4. Punjab - -	219,610	22,956,970	32	30	2,440	32	3,000	Nil	E. J. Cunningham.
5. Oudh - -	23,992	11,220,232	12	1	500	3	1,737	Nil	C. M'Minn. Dr. Selons.
6. Central Provinces -	113,797	9,251,229	19	1	769	1	769	Nil	C. Grant.
7. Bombay and Sind -	191,834	23,180,721	24	2	1,230	2	1,474	15	J. M. Campbell. A. W. Hughes.
8. Madras - -	147,789	34,962,005	21	5	3,086	6	3,476	15	The District Officers.
9. Berar - -	17,631	2,226,496	6	1	317	1	317	Nil	A. C. Lyall.
10. Mysore - -	29,325	5,055,412	8	1	500	2	1,249	Nil	L. Rice.
11. Coorg - -	2,000	168,312	6	Nil	Nil	1	312	Nil	L. Rice.
12. British Burmah -	88,556	2,747,148	15	Nil	Nil	1	264	Nil	Captain Spearman.
13. Ajmere and Mhairwara	2,711	396,889	1	1	104	1	104	Nil	J. D. La Touche.
14. Aden - -	35	22,722	1	Nil	Nil	1	235	Nil	Captain F. M. Hunter.
	1,174,606	210,573,742	240	59	17,324	78	25,440	50	

The Statistical Survey is now completed for four-fifths of British India, that is for 190 out of 240 districts, and 78 volumes of statistical accounts, aggregating 25,440 pages, have been printed.

In BENGAL (population 62,815,370; 47 districts), by which is meant the province under the Lieutenant-Governor of Bengal, comprising a third of the population of British India, the work was entrusted to Dr. Hunter, as Provincial Compiler, in addition to his duties as Director-General of Statistics. The work of collecting the materials and personally visiting the districts occupied him till 1874. The compilation was then started, and the work had made some progress, when the high cost of literary compilation in India and the magnitude of the undertaking, made it apparent to the Government that the work would be cheaper done in England. Estimates were framed, and, it having been calculated that the adoption of this plan would reduce the period from four years to 23 months, and the cost from 17,000*l.* to 5,450*l.*, the arrangement was sanctioned, and Dr. Hunter was directed to proceed to England with all his materials and there engage a literary staff. The result has justified the expectations of the Government. On the 16th of November 1876 the Statistical Account of Bengal was completed in 20 volumes, aggregating 8,246 pages, and on the 20th December 1876 the Lieutenant-Governor published in the "Calcutta Gazette" the final orders of the Government.*

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* Extract from the Orders of the Government of Bengal, No. 4045, dated Calcutta, 20th December 1876.

Para. 3. "Sir Richard Temple cannot but regard these results with high satisfaction. He regards them as eminently creditable to you. Every volume of the Statistical Accounts has passed under his own personal supervision, and he is able, therefore, to testify to the quality of the work. The thanks of the Government of Bengal are emphatically due to you for the vigour and energy with which you have accomplished the collection of such diverse and varied information, and for the ability and literary skill which you have uniformly displayed in dealing with, sifting, and analysing and arranging materials supplied to you from so many quarters.

Para. 4. "The Lieutenant-Governor's thanks are also accorded to the Assistants who have laboured under your directions in compiling several of the Accounts. The names of Mr. J. S. Cotton, late Fellow and Lecturer of Queen's College, Oxford; Mr. H. H. Risley, of the Bengal Civil Service; and Mr. C. A. Dollman, are especially mentioned in your letter. I am to request that you will communicate to each of these gentlemen an expression of the Lieutenant-Governor's thanks and approbation of their work.

5. "It only remains that the Lieutenant-Governor should record his further

ASSAM. — Population, 4,132,019; 13 districts. The Statistical Account of this Province was also retained in Dr. Hunter's own hand as Provincial Compiler. By 1875 the materials were collected, and they were revised on the spot at intervals during the next two years. But on visiting the Province in 1876, Dr. Hunter found that the late administrative changes since Assam had been erected into a separate Chief Commissionership necessitated further revision, which Dr. Hunter carried out. The brief period which has elapsed since these administrative changes has rendered it impossible for the District Account to be brought up to the standard aimed at in the Statistical Accounts of the older Bengal districts. The work for Assam is completed in two volumes, aggregating 917 pages, and its publication only awaits the maps now on their way to England.

NORTH-WEST PROVINCES. — Population, 31,438,217; 35 districts. The compilation of the Statistical Account was here entrusted to a special officer. In 1876 four volumes, comprising 13 districts, and aggregating 2,840 pages, had been printed. In 1876–77 the Provincial Compiler was withdrawn from special duty, since which time one more volume has been printed, and two districts have been compiled. A series of brief district abstracts have been therefore obtained from the compiler and his *locum tenens*, to serve as materials for the Imperial Gazetteer, but it is not possible as yet to assign a date for the completion of the Gazetteer.

PUNJAB.—Population, 22,956,970; 32 districts. The work was here made over to a member of the Lahore Bar, and the 32 districts are treated of in 32 small volumes, aggregating about 3,000 pages. The Punjab volumes Dr. Hunter considers susceptible of much improvement, but at the same time he thinks it would be inexpedient to attempt a revised edition before the next Census of 1881; the last enumeration of the people having been made in 1868, before the

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acknowledgments to the District and Sub-divisional Officers under the Government of Bengal, who, with great personal trouble, have supplied, from their local knowledge and resources, the detailed information on which the whole of the Statistical Account of Bengal is necessarily based. The active co-operation of all officers in Bengal has, as you fully acknowledge, at all times been cordially extended to you in your inquiries. The Lieutenant-Governor congratulates you and your Assistants, and the District Officers of Bengal generally, on the successful completion of the Statistical Account of Bengal."

principles of the Indian Census had been elaborated. The present edition of the Punjab Statistical Accounts, together with the valuable settlement reports of the various districts, and the yearly administration returns yield fairly adequate materials for the Punjab articles in the Imperial Gazetteer.

In the SEVEN MINOR ADMINISTRATIONS the work has been much less complicated, and the Statistical Accounts for all of them are now complete. They comprise (1) Oudh, (2) Central Provinces, (3) Berar, (4) Mysore, (5) Coorg, (6) British Burmah, and (7) Ajmere with Mhairwara, having in all 67 districts and an aggregate population of 31 millions. In these minor administrations the complexity and difficulties were incomparably less than in large and powerful administrations like Bengal, Madras, and Bombay, which were each characterised by local developments and divergencies. The chief difficulty in the case of the minor administrations has been in the scanty resources of the local printing offices. The work has been done with very different degrees of accuracy and completeness; but of Mysore, Dr. Hunter observes that the volumes compiled by Mr. Lewis Rice, Director of Public Instruction (who has also compiled that for Coorg), are better than anything he himself has been able to do even for Bengal. Mysore will shortly return to native rule, and these volumes form an invaluable record of what an episode of honest English administration has effected for an Indian State. The accounts for the Central Provinces and Berar were practically done before the present statistical operations commenced. Dr. Hunter pronounces them excellent of their kind, and he is now revising them by the light of recent returns and administrative reports for articles in the Imperial Gazetteer. The Statistical Account of Ajmere and Mhairwara as first compiled proved to be inadequate, but the renewed operations have since been carried out by an able Settlement officer in addition to his other work. Those for British Burmah have occupied a longer period, but the whole is being now printed off. They contain a striking picture of the meaning of English rule in a backward Province. What were fishing hamlets or mud banks when the country passed into our hands are now busy harbours and populous centres of commerce.

BOMBAY AND SIND.—Population, 23,180,721; 24 districts. The

work here has been much delayed, the Provincial Compiler having been often withdrawn to compile the Annual Administration Report of the Presidency, and Dr. Hunter has consequently arranged for the supply of a series of brief abstracts for the purposes of the Imperial Gazetteer. According to the most recent information, four districts accounts of the Bombay Presidency (exclusive of Sind) have been compiled, leaving 15 still to be completed. The Statistical Account of Sind, which in some respects forms a minor administration, was admirably done by Mr. A. W. Hughes of the Uncovenanted Service, and a second edition has been published in England. Mr. Hughes has also lately put forward a very useful work on Baluchistan.

MADRAS. — Population, 34,962,005; 21 districts. The arrangements adopted in 1862 provided for the preparation of a "Manual" for each district, and since the issue of those orders six* have been completed, 15 remaining uncompleted. A series of abstract accounts of the uncompleted districts has, however, been furnished for the purposes of the Gazetteer, but the completion of the District Accounts is still unprovided for.

ADEN. — Population, 22,722; 1 district. An account of this Settlement has been prepared by Captain F. M. Hunter, First Assistant Resident.

Summarising the operations in British India, it may be observed that during the past seven years the operations have been completed and the Statistical Accounts printed for four-fifths of British India, including all the eight minor administrations, including Assam, and two of the five first-class governments, viz., Bengal and the Punjab.

The scope of the Imperial Gazetteer was thus defined by the Secretary of State.† "The Imperial Gazetteer will be the condensation and fruit of a series of Statistical Surveys of each of the Administrative or Political Divisions of India, specially and minutely compiled within moderate limits of time; and it will thus occupy a very different position from all previous essays in this direction, in which the materials were derived in part from data which were

* Bellary, Cuddapah, Godavari, Madura, Nellore, and Vizagapatam.

† Despatch from the Secretary of State to the Governor-General of India, dated 22nd February 1877.

frequently far from contemporaneous, and often no better than the chance records of travellers."

As the Secretary of State's Despatch of 1867 had led to the organisation of the Statistical Surveys in 1871, so the Despatch of 1877 formed the basis of the Imperial Gazetteer. Under its instruction Dr. Hunter organised an office and staff in Edinburgh, by the members of which the various articles are being prepared under his general supervision. As an administrative guide-book the Gazetteer will be somewhat impaired by the statistics not being brought up to date, the census of 1872 being still the basis of Indian statistics for most of the provinces, and this necessitating contemporaneous statistics for all the various branches of the Administration. Complete uniformity has not been attainable owing to the various changes made since, such as the creation of Assam into a Chief Commissionership, and the amalgamation of Oudh with the North-west Provinces. The figures will, however, represent the facts substantially between 1872 and 1878.

As a book for general information the Imperial Gazetteer will, Dr. Hunter fears, be deficient in archæological details, as the Archæological Surveys of India and Bombay are still at work, and that of Madras is not yet begun. The Statistical Survey of India was deficient too, in the fact that the Native or Feudatory States were omitted from its scope. A special assistant, Mr. Roper-Lethbridge, has, however, been appointed to compile (in communication with the Foreign Department, Calcutta) articles on the Native States for publication in the Imperial Gazetteer, and Dr. Hunter considers that those already prepared mark a vast stride in advance beyond anything that has hitherto been done towards the elucidation of the Native States. The Imperial Gazetteer will also contain, for the convenience of reference, articles on independent neighbouring States beyond the British frontier, but these will be compiled simply from materials already before the public, and will be of a strictly non-official character. The identifications of names of places will be provided for by the insertion of the co-ordinates of latitude and longitude, which will be furnished by the Surveyor-General of India.

The Imperial Gazetteer will contain from five or six to 20 or 30 names for each district of British India. These names will include those of (*a*) the Presidencies and Provinces; (*b*) all Divisions

or Revenue Commissionerships; (*c*) Districts, Collectorates or Deputy Commissionerships; (*d*) all Sub-districts in Provinces where the sub-divisional system has been introduced, and where this has not been introduced; (*e*) the separate administrative unit such as the *táluká* or other rural area with local court-house and an executive officer in charge; (*f*) any Native States or foreign territories; (*g*) important hills or ranges; (*h*) important rivers, lakes, marshes, or canals; (*i*) towns containing 5,000 inhabitants, and in addition (*j*) all municipalities or towns and rural unions with a municipal constitution; (*k*) trading and manufacturing towns; (*l*) places of historical interest, battle fields, old fortresses, scenes of great religious gatherings, and plans of architectural interest. Besides the above, all military cantonments or fortresses in occupation by troops (but not temporary outposts), and features of the coast in maritime districts, such as ports, harbours, really important roadsteads, capes, lighthouses, islands, &c.

The spelling of the proper names in the Gazetteer will be regulated according to the Provincial Lists prepared for each Province of British India. Those for Madras and British Burmah have, however, not yet been received, so that the amalgamated index, which will probably contribute more than anything else towards the eventual general adoption of the scheme resolved upon, cannot be yet prepared. With the exception of the names which are supposed to have acquired a fixity of spelling in British India, the proportion of which to the bulk of the names varies considerably in the different Provinces, the system will be in accordance with that advocated by Dr. Hunter, which adopts a uniform value for each letter, and takes as its basis the Indian vowel sounds of *a* and *u* as in *rural*, *e* as in *grey*, *méchant*, and *i* and *o* as in *police*.

IX.

Trans-frontier Explorations, and Miscellaneous.

During the year 1876, "the Mullah," one of the native explorers attached to the Great Trigonometrical Survey Department, made a survey of the Indus from Amb, where it enters the plains above Attock, to its confluence with the Gilghit River. All other portions of the course of the Indus, from its source in the plateau of Tibet to its mouth, have long since been surveyed, but hitherto

this portion has been merely "dotted in" on our maps. Here it traverses a distance of some 220 miles, descending from a height of about 5,000 to 1,200 feet above sea level. Its course is tortuous, amid encompassing ranges, the peaks of which are rarely less than 15,000 feet in height, and culminate to the north in the well-known giant mountain Nanga Parbat, 26,620 feet high. In many places the river is hemmed in so closely by these great ranges that its valley is but a deep-cut narrow gorge, and as a rule there is more of open space and culturable land in the lateral valleys than in the principal valley itself.

The positions and heights of all the most commanding peaks in this region had been long fixed by Captain Carter's observations at trigonometrical stations on the British frontier line, and some native itineraries collected by Dr. Leitner were combined by Mr. E. G. Ravenstein in a map published in the "Geographical Magazine" for August 1875. No European or scientific traveller, however, is known to have penetrated into it. It is very difficult of access from all quarters, and is inhabited by a number of hill tribes, each independent and suspicious of the other, who are in a great measure separated and protected from each other by natural barriers and fastnesses. As a whole the region has never been brought into subjection by any of the surrounding Powers. Each community elects its own ruler, and has little intercourse with its neighbours, and with the outer world communicates only through the medium of a few individuals who have the privilege of travelling over the country as traders. The Mullah possesses this privilege, and thus in the double capacity of trader and explorer, he traversed along the Indus, and through some of the lateral valleys, leaving the others for exploration hereafter.

This work done, he proceeded, in accordance with his instructions, to Yassin, marching through the Gilghit Valley, but not surveying it, because the labours of the late Captain Hayward, who was murdered at Yassin, already supplied a good map of that region. From Yassin he surveyed the southern route to Mastuj through the Ghizar and Sar Laspur Valleys; this has furnished an important rectification of a route which had hitherto been laid down from conjecture only, and very erroneously; for the road, instead of proceeding in a tolerably straight direction from Yassin to Mastuj, as was supposed, turns suddenly from south-west to north-north-

east at Sar Laspur, which is situated at some distance to the south of the direct line, in a valley lying parallel to the valley of Chitral. At Mastuj the Mullah struck on to his old survey of the route from Jelalabad, *viâ* Dir and Chitral, to Sarhadd-i-Wakhan, in 1873, and then proceeded along that route towards the Baroghil Pass, as far as the junction of the Gazan with the Yarkhun River, and then along the northern road from Mastuj to Yassin. This road turns up the Gazan Valley, crosses the Tui or Moshabar Pass—which is conjectured to be not less than 16,000 feet in height — and, after traversing a deep crevassed glacier for a distance of about eight miles, reaches the point where the Tui River issues in great volume from the glacier; the road then follows the course of the river down to its junction with the Warchagam River, a few miles above Yassin.

Returning to Sar Laspur, the Mullah next surveyed the route to the south-west, up the valley leading to the Tal Pass. This pass is situated on a plateau of the range which connects the mountains on the western boundary of the valley of the Indus with those on the eastern boundary of the valley of Chitral, and is generally known by the people of the country as the Kohistan. The sources and most of the principal affluents of the Swat and the Panjkora Rivers take their rise in this region, all the most commanding peaks of which were fixed by Captain Carter's triangulation; but of the general topography of the valleys relatively to the peaks nothing at all definite has been known hitherto. The Mullah has done much to elucidate the geography of this region. On crossing the Tal plateau he descended into the Panjkora Valley, and traversed its entire length down to Dodbah, at the junction of the Dir River with the Panjkora, where he again struck on his route survey of 1873.

As circumstances prevented him from going down the Panjkora to its junction with the Swat River, he travelled along the Havildar's route of 1868 as far as Miankalai, and then surveyed the road to Nawagai and on to Pashat in the valley of Kunar, and, finally, returning to Nawagai, he surveyed the road thence down to the British fort of Abazai.

The explorations of the Mullah have thus added much to our knowledge of the geography of the interesting regions lying beyond our northern Trans-Indus Frontier. A good deal, however, still remains to be done before our knowledge of these regions is as full

and complete as it should be, and Colonel Walker promises that every effort will be made to carry out further explorations as soon as possible.

A sketch map has been constructed to illustrate the Mullah's operations; it also shows the localities where more information is wanted. In the north-east corner the results of a recent reconnaissance of portions of the Karambar and the Nagar Valleys by Captain Biddulph are given, but somewhat modified from his map of the country.

During 1877, Colonel C. M. MacGregor, C.S.I., and Captain R. B. Lockwood, of the Quartermaster-General's Department, made an important reconnaissance of the desert of Baluchistan. The results have been embodied in a cartographic form on the new map of the territories of the Khan of Khelat, published in the Surveyor-General's Office at Calcutta, but the journals have not yet been made public. Starting from Gwadar and Pasni on the Mekran coast, the routes of these two officers soon converge and extend northward towards Kuhak, contributing some additional topography to Major St. John's map. After skirting the Kuhak territory on its eastern side they followed the course of the Mashkel (not Mashkid) River, which is found to bend eastward and then again to the north-west, flowing into a swamp or *hamun*, called Mashkel Hamun, and situated about 28° 15′ N. latitude. They then proceeded due north as far as about 29° 13′, and thence diverged north-westwards to Shah Godar, skirting a range of hills running due east and west, the southern drainage of which converges into the Kindi or Talab Hamun west of the Mashkel Hamun, and the northern face of which drains in the direction of God-i-Zirreh, a salt waste (quite dry at the time visited) which occupies the centre of a depression between the range just mentioned and the Helmand River. Shah Godar, the limit of the journey, is situated on the western bank of a canal flowing into the God-i-Zirreh. On the return journey, Colonel MacGregor crossed several streams running south-west into the Kindi and Mashkel swamps; he then proceeded eastwards between two long narrow ranges of sand hillocks south of the Lora swamp, and crossing (for the second time,) Captain Pottinger's route of 1810, from Nushki to Budu, returned to India by way of Sohrab and the Gundava Pass.

Captain Lockwood took a different route on his return journey. He visited Chageh, on the *hamun*, in which the Lora River deposits

its waters, and the centre of which is situated about 29° 20′ N. latitude and 64° 40′ E. longitude. It appears to be shut in on three sides by sand hills. Skirting the southern side of the swamp he made for Nushki, and returned to India *viâ* Mustang and the Bolan Pass.

The result of this exploration is to help to fill up an extensive blank in the Baluchistan desert south of the Lower Helmand, and to fix approximately, amongst other things, the position of the depression in which the Lora discharges itself. Another more important result is to shed some further light on the question of the northern boundary of Baluchistan. The published map, above referred to, modifies the northern frontier of the country slightly from the line laid down in Colonel Walker's Turkistan map, and makes it run E.N.E. from Kuh Malik-i-Siyah, then to skirt the southern or left bank of the Helmand, without crossing the river, and then to stretch across the desert towards Quetta. The northern and north-western frontiers of Baluchistan have, however, never been surveyed, so that these lines can only be regarded as approximations.

During the current year the geographical business of the India Office has been transferred to the Statistics and Commerce Department. Among the most important labours of the Geographical Section or Department have been the publication of the General Catalogue of Manuscript and Printed Reports, Field-books, Memoirs, Maps, &c. of the Indian Surveys, deposited in the Map Room of the India Office, and that of the second edition of the Memoir on the Indian Surveys. The scope of these works has been fully described, both in the "Abstracts of Surveys" and in the second edition of the Memoir itself. It only remains to state that the former work forms a volume of over 600 pages, and, by means of the copious index attached, any one can ascertain quickly what geographical information, published or unpublished, is available in the Map Room of the India Office respecting any given locality. The second edition of the "Memoir on the Indian Surveys," is, generally speaking, built on the lines of the first edition, but is brought up to date and includes a review of all Indian geographical operations up to the close of the season 1875–76. It is from the pen of Mr. C. R. Markham, C.B.

The Map of Afghanistan, mentioned at page 60 of the Abstract for 1874–5, has been nearly completed. This important work, which

has been compiled by Major Wilson from all available materials which could be obtained from the various Government Departments in India, includes the country from Herat to the Indus, and from the Oxus to the Mekran coast. It is contained in 20 sheets, and is on the scale of 8 miles to the inch. All the portion south of the Hindu Kush has been completed and is now undergoing redrawing preparatory to reproduction at the Ordnance Survey Office, Southampton.

CHARLES E. D. BLACK.

Statistics and Commerce (Geographical) Department,
India Office,
November 1878.

LONDON:
Printed by GEORGE E. EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty.
For Her Majesty's Stationery Office.
[1869.—250.—1/79.]

ABSTRACT

OF THE

REPORTS OF THE SURVEYS,

AND OF OTHER

GEOGRAPHICAL OPERATIONS

IN

INDIA

FOR

1877–78.

752

B B. a. 410

PRINTED AND PUBLISHED BY ORDER OF
HER MAJESTY'S SECRETARY OF STATE FOR INDIA IN COUNCIL.

LONDON:
SOLD BY
W. H. ALLEN & CO., 13, WATERLOO PLACE;
EDWARD STANFORD, 55, CHARING CROSS;
N. TRÜBNER & CO., 57 & 59, LUDGATE HILL;
W. B. WHITTINGHAM & CO., 91, GRACECHURCH STREET;
W. THACKER & CO., 87, NEWGATE STREET.

1879.

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Marine Surveys of India, 1877–78.

The operations of the Indian Marine Survey Department during the year 1877–78 divide themselves into three categories:—(1) The Superintendent Commander Taylor's tours of inspection of the ports between Calcutta and Bombay; (2) the surveys executed; and (3) the work done in and in connection with the Drawing Branch.

In June 1876 Commander Taylor had dwelt on the necessity of his ascertaining the immediate wants as regards navigation of all the ports touched at by the vessels of the British India Steam Navigation Company between False Point and Beypore. Owing to various reasons this trip had been deferred, but on the 30th March 1877 he started thereon, having previously obtained sanction for continuing the inspection as far as Bombay. Twenty-two ports were visited, and detailed notes thereon were prepared by Commander Taylor. The whole coast from False Point lighthouse to Bimlipatam has never been subjected to even a preliminary examination, and will be surveyed as soon as the new surveying steamer is available. Besides this work, detailed surveys of various localities are much required. An extensive erosion of the sandy point at False Point has taken place; below Hope Island lighthouse to the Sacramento shoal the foreshore is said to have extended seaward, and soundings are needed. A survey of the entire bay of Masulipatam from Divy Point to Nursapur, as well as of Nursapur river, is required Madras roadstead is undergoing changes consequent on the seaward extension of the groynes, and should be periodically examined; of Paumben Pass a large scale survey soon proved to be urgently required, and Mr. Morris Chapman, I.N., was accordingly deputed to execute this. Commander Taylor thinks that a good steam dredge like the "Albuquerque" would soon deepen the passage at Paumben to 15 feet, which would admit of several of the British India coasting steamers passing through; but a ship canal, with the necessary lights and other accompaniments, would be so costly that he fails to see any commensurate advantage which would result from its construction. At Cochin the merchants are anxious that the river

bar should be dredged, but the result of an examination made by Lieutenant Hammond was to show that no useful permanent effect would be derived from such a step. Carwar had been visited and reported on on two previous occasions by Commander Taylor. A steam launch proved to be much needed here to tow cargo boats out, to facilitate communication with the Oyster Rocks lighthouse during the monsoon months, and to assist pilots in reaching vessels at the same period.

During Commander Taylor's stay at Bombay he was engaged in fixing the position of the fishing stakes, which were alleged seriously to hinder navigation. He hopes shortly to publish a small sheet showing the position of the outer stakes, and the Master Attendant's Department can henceforth see that the lines are systematically adhered to, and all ground of complaint removed. Commander Taylor ascertained that Rajpuri, Jaigurh, Ratnagiri, Viziadurg, Malwan, and Vingorla greatly required surveying. In the case of Ratnagiri, he discovered that the adjoining Kalbadevi Bay possesses an excellent harbour, which, by the expenditure of a few thousand rupees and the preparation of a chart, would, on the completion and opening for traffic of the Amba Ghat, afford access by sea to Kolhapur, Satara, and the Deccan generally. Lieutenant Jarrad was accordingly deputed to execute the survey of these various ports during the season of 1877–78. At the request of the Governor of Bombay, Commander Taylor endeavoured to investigate the question of the supposed silting up of the upper portion of Bombay harbour. This necessitated a careful examination of all old charts, and various old accounts of the island and harbour. The conclusion arrived at was that no inconvenient silting is at present taking place off Mazagon foreshore.

In August 1877 Commander Taylor detected an error in the published position of Santipilly lighthouse. A visit to the spot verified the suspicion, the light proving to be 1½ miles N.E. of its position on the chart.

During the year the surveying operations have been carried on entirely by boat parties, in the absence of a suitable steamer. It has thus been necessary to select such localities for survey as afforded convenient camping ground, tolerably smooth water, and facilities for sheltering boats. No. 1 party, consisting of Lieutenants F. W.

Jarrad, C. W. Petley, and T. C. Pascoe, R.N., Mr. P. J. Falle, and Surgeon J. Armstrong, proceeded to Ratnagiri and surveyed this port, as well as Mirya and Kalbadevi Bays, a task which occupied nearly four months in all. The chart is beautifully executed, and comprises 38·6 miles of coast and high-water line, trigonometrically laid down, and 21·5 square miles of water closely sounded to a distance of three miles from the coast. The soundings were reduced to the lower low-water ordinary spring tides. Tidal observations, continued day and night, were extended over a period of four months, November to February, inclusive. Lieutenant Jarrad's party also surveyed Viziadurg, including Rajapur and Ambol Ghur Bays, and took a two months' series of tidal observations. Magnetic observations were also instituted, but owing to the large per-centage of iron contained in the laterite overlaying the coast rocks, considerable difficulty was experienced in these operations.

No. 2 party, under Mr. M. Chapman,* assisted by Lieutenant Coomb, R.N., was despatched from Calcutta to survey the Paumben Pass, and arrived there on the 13th October 1877, exactly 40 years from the time the last survey of that locality was commenced under Commanders Powell and Ethersey, of the Indian Navy. Owing to Major Branfill, of the Trigonometrical Survey of India, having fixed several stations in this locality in 1875, Mr. Chapman's labours were greatly facilitated, and an easy and accurate connection was established between the terrestrial and marine surveys. The total area surveyed amounted to 36 square miles, which was sectionally sounded with great care. Observations of the tides, and for magnetic variation, were obtained, and sailing directions and remarks on the Paumben Pass were issued in the form of a Hydrographical Notice. The charts completed by the party are two in number, showing the Paumben Pass and the approaches thereto, respectively. Mr. Chapman has prepared a useful note on the Paumben Pass, in which he has put together briefly, but in an interesting shape, such information on its history as exists, from which it appears, on the evidence of the records of the celebrated temple of Ramiseram, to which so many pilgrims annually resort from all parts of India, that early in the 15th century Ramiseram Island was connected with the mainland by a narrow strip of land. In 1480, however, this neck of

* Since deceased

land was breached during a violent storm, and though the breach was repaired, chiefly in the interests of the pilgrims, succeeding storms widened the breach past all hope of remedy. The first step towards the utilization of the channel appears to have been taken by a certain Colonel Manuel Martinez, who recommended to Mr. Lushington, Collector of the Southern Provinces of India, and afterwards Governor of Madras, the advantage of deepening the channel, and so saving the long route round Ceylon, besides opening up the trade of the Coromandel and west coasts. Nothing, however, was done till 1822, when Colonel de Haviland recommended the institution of a regular survey, and Ensign Arthur Cotton, who was deputed to the work, reported in favour of improving and deepening the channel. The Burmese war diverted attention therefrom for the time, but in 1828 it was decided that Major Sim should proceed to Paumben and make experiments in blasting and removing the rocks. Major Sim's interesting report, with a small chart of Paumben, will be found in the Journal of the Royal Geographical Society, and shows what the pass was in 1830, since when works have been carried on which, up to the year 1854, cost a sum of Rs. 3,50,000, when a depth of 10 to 12 feet of water was obtained, and vessels could safely navigate the pass and Sandbank Channel without having to discharge their cargo. The greatest number of vessels passing through was registered in 1876, when the aggregate tonnage amounted to 269,544 tons. In 1878 it was 136,579 tons.

Mr. Chapman also acquired detailed information regarding the nature of the bottom of the channel, which will be found most valuable if dredging be resorted to.

On the west coast of India Lieutenants Hammond and Pascoe, R.N., inspected the ports of Cochin, Beypore, and Calicut. At the first-named port the position of the lighthouse, which was wrongly marked on the charts, was corrected, the port boundary marks were fixed, and the coast line between the two re-surveyed. A great change on the north side of the river had taken place since the last survey, nearly half of Vypeen Island having been wasted away. Various minor alterations in the bar, &c., were noted, but at Cochin the changes, both in the foreshore and off the river entrance, proved to be so great as to call for an early and thorough re-survey. About 10 years ago the monsoon sea breached through Vypeen Island at

Cruz Milagre, about two miles north of Cochin town, and so great a body of water rushed through that, although two years later the gap was closed up, the main ebb stream of Cochin backwater was greatly weakened, and the narrow sandy ridge of the bar was pushed by the heavy monsoon swell about one cable's length further inward. This accounts for the changes discovered by Lieutenant Hammond. At Beypore some rocks reported south of Rocky Islet were examined, and the buoy placed there was fixed, and at Calicut several important additions and corrections were made to the existing charts. Lieutenant Hammond then returned to Madras, and thence to England, and Lieutenant Pascoe to Calcutta, where he was engaged during the recess in preparing the fair drawings of the extended survey of Madras, which has been shown on one sheet, and plotted on the scale of 10 inches to one nautic mile.

Commander Taylor reports that, in addition to the surveys made by Captain A. de Richelieu, of the Siamese Royal Navy, along various portions of the Siamese coast, which have already been embodied in some of the Government of India publications, most important hydrographic work has been carried on by Captain A. J. Loftus, Topographer and Marine Surveyor to the Siamese Government, along the west coast of the Gulf of Siam from Hilly Cape to Lem Chang P'ra, a distance of upwards of 300 miles, embracing Singora, Patani, and other hitherto unsurveyed anchorages. The work has been most creditably produced; elaborate notes have been appended to the sheets, explaining how the survey has been carried on, and numerous views of the coast are given. The results of his labours are being published by permission of the Government of India as rapidly as possible.

The steamer now in course of construction in Bombay Dockyard for the Indian Marine Survey will probably be ready for sea next year. Besides being specially equipped for coast surveys, she will be fitted (in accordance with the representations of the Asiatic Society of Bengal) with dredging and sounding apparatus similar to that used in Her Majesty's ship "Challenger" during her cruise. She is named the "Investigator." Her dimensions are as follows:—Length 203 feet, breadth 25 feet, and burthen 583 tons. Lieutenant Jarrad, who will command the vessel, had the advantage, during his stay in England in the latter part of 1877, of conferring with Sir Wyville

Thomson, who kindly furnished him with all the information regarding the special fittings and instruments necessary for a physical investigation of the Indian Ocean, and on every point gave him the benefit of experience gained during the voyage of the "Challenger." Other members of the "Challenger" staff gave advice respecting the manipulation of the special appliances, specimens of which have been kindly furnished by the Admiralty, and sent out to India as patterns.

The natural history investigations of the season have been confined to the examination and collection of the fauna inhabiting the shores in the vicinities of Ratnagiri and Viziadurg. The area examined includes the tract of country lying between the sea and the western ghats. It is only on the slopes of these hills that the various fauna begin to be at all abundant, or to assume any individuality of their own. All the intervening tract of country is parched and barren, being composed of a thin soil overlying a substratum of trap rock or laterite, which appears to contain elements highly detrimental to the development of animal organisms.

Among the publications prepared by the Marine Survey Department during the year may be mentioned a tabular statement showing the cost of erection of all the lighthouses and light vessels in British India, together with their positions, distinctive characteristics, &c., and cost of maintenance during the years 1871–74. A statement giving similar information up to date is in preparation. A return of wrecks and casualties in Indian waters during 1876–77 was also issued during the year under review. Commander Taylor states that, owing to the orders of Government, the necessary returns on which this compilation is based are forwarded from the out ports with much greater promptitude and regularity than formerly. But more stringent measures are needed to insure information of casualties being regularly brought to the notice of Government.

During the year, 34 notices to mariners relating to new lights, buoys, and newly discovered dangers have been published, and a large number of copies of these and of hydrographic notices have been issued. These Indian nautical notices, it is satisfactory to observe, are reproduced at all the principal hydrographic departments throughout the world. A chart depôt has been established

in Calcutta, and printed lists of all new charts and hydrographic publications have been issued by the Superintendent of Government Printing, from whom Admiralty charts will in future be obtainable. The number of copies of charts issued during the year was 3,630, and the amount realized by the sale of charts was Rs. 1,286.

Many important new charts and other publications were issued by the Compiling and Drawing Branch; among these may be mentioned a new chart showing the off-lying dangers and approaches to Galle. A preliminary chart of the Vizagapatam, Ganjam, and Orissa charts was prepared, and a similar one for Goa and Marmagao roadsteads. During the twelve months the large number of 10,874 charts were corrected for new lights, buoys, beacons, newly discovered rocks, &c., the information concerning these corrections having been taken from the numerous notices of marine and hydrographic notices issued from the various hydrographic establishments throughout the world.

The Return of Wrecks and Casualties in Indian Waters for 1878 has just reached this country. It shows a larger total of recorded wrecks and casualties than any previous year, the total number of vessels wrecked being 59, with a loss of 115 lives, and the casualties 131, with a loss of 16 lives. It is preceded by an able and exhaustive analytical review, by Mr. Carrington, and the Report, which is more voluminous than any of its predecessors, is altogether one of the greatest importance with reference to Indian commerce and navigation. There are some useful notes at the close of the Report on the weather experienced at the principal ports round the Indian coasts in 1878. The weightiest suggestions, however, are those with reference to legislation in regard to wrecks, courts of inquiry, unseaworthy vessels, &c.

The Marine Survey Department on the 31st March 1878 consisted of one Superintendent, two Deputy ditto, one Superintendent of the Drawing Branch, seven Assistant Superintendents (and two vacancies), and one medical officer and naturalist, besides clerks, draftsmen, &c. The cost of the Department for the year ended the same date was Rs. 1,38,290. 7. 2.

Land Surveys.—Introductory.

The annual reports of the Land Survey operations embrace the period known as the survey year, which does not correspond with either the calendar or the official year, but is usually reckoned from the 1st October, when the surveyors are again taking the field, after having completed the mapping calculations, &c., of the previous season.

On the 1st October 1877, when the year under review commenced, Major-General Thuillier, C.S.I., R.A., held the post of Surveyor General and Superintendent of the Topographical Branch of the Department, and retained charge of the same until the close of the year. On the 1st January 1878 an important amalgamation of the three branches* took place. Up to that time these three branches had been virtually separate Departments, each with its own cadre of officers and establishment of European and Native surveyors, and its own Superintendent. Originally, when the three branches were first formed, which was at different times, their respective duties were essentially distinct. The Trigonometrical Survey furnished the framework within which all surveys of interior details were filled and connected, while these interior details were supplied by the Topographical and Revenue Surveys, the former of these two surveying by means of plane tabling the Native States and poorer British districts, and the latter the richer districts. In course of time, however, the duties of these three branches got mixed up. The Great Trigonometrical Survey was approaching completion, and for many years a large proportion of its officers had been engaged on topographical surveys on various scales; the Topographical Branch, though originally intended for the execution of the primary general surveys of India, had similarly to undertake detailed surveys on large scales, and the Revenue Department, which was designed for the survey of rich British districts in the plains of India, leaving all hilly and difficult country generally to the Topographical, had for some years past been largely employed in the topography of hill districts on a trigonometrical basis.

Thus a fitting time had arrived for remodelling the Survey Department and fusing the three branches into one, and this was accordingly carried into effect, and the amalgamated Department termed "the Survey of India."

* Great Trigonometrical, Topographical, and Revenue.

It consists of the following :—

1 Surveyor General and Superintendent of the Trigonometrical and Topographical Branches.
1 Deputy Surveyor General and Superintendent of the Revenue Branch.
4 Deputy Superintendents, 1st Grade.
10 „ „ 2nd „
12 „ „ 3rd „
11 Assistant Superintendents, 1st Grade.
11 „ „ 2nd „
12 „ „ 3rd „
9 Surveyors, 1st Grade.
12 „ 2nd „
16 „ 3rd „
22 „ 4th „
23 Assistant Surveyors, 1st Grade.
25 „ „ 2nd „
27 „ „ 3rd „
29 „ „ 4th „

The two offices of Superintendent of the Great Trigonometrical Survey and Superintendent of the Topographical Survey, separated since the time of Sir Andrew Waugh, have now been merged into the duties of Surveyor General of India, to which office Colonel (now Major-General) J. T. Walker, C.B., F.R.S., Royal (late Bombay) Engineers, was appointed on the 1st January 1878, Major-General D. C. Vanrenen, R.A., retaining charge of the Revenue Survey Branch in the capacity of Deputy Surveyor General and Superintendent of Revenue Surveys.

The number of officers in each of the executive grades has been reduced in consequence of financial pressure, and since the reorganization of 1874 the Department has lost the following appointments :—

1 Superintendent, Great Trigonometrical Survey.
1 Joint Superintendent, Revenue Survey.
6 Deputy Superintendents.
2 Assistant ditto.
3 Assistant Surveyors General.
4 Surveyors.
4 Assistant ditto.

During the year under review the operations of the Indian Survey have been as follows :—

Nature and *Locale* of Operations.	Executive Officers.	Old Designation.	Remarks.
Triangulation.			
Madras - -	Lieut.-Col. B. R. Branfill.	Madras Party - -	Principal triangulation.
Tavoy - -	Captain J. Hill. R.E.	Eastern Frontier ditto	Ditto.
Eastern Sind -	Captain M. W. Rogers, R.E.	Bombay ditto - -	Principal triangulation suspended; secondary triangulation and geographical reconnaissance towards Quetta undertaken.
Assam - -	Lieut. H. J. Harman, R.E.	Assam Triangulation -	Secondary triangulation and geographical reconnaissance.
Burmah - -	Mr. W. G. Beverley -	Burmah ditto - -	Secondary chains resting on Eastern Frontier Series.
Topography.			
Central India -	Captain C. Strahan, R.E.	No. 1 Topographical Survey.	Scale 1 inch to the mile.
Khandesh - -	Mr. H. Horst - -	No. 2 ditto - -	Scale 1 and 2 inches, for publication on 1 inch scale.
Malwa - -	Captain J. R. Wilmer, S.C.	No. 5 ditto - -	Scale 1 inch.
Khasi and Garo Hills.	Major W. F. Badgley, S.C.	No. 6 ditto - -	Various scales, 1 inch to $\frac{1}{4}$ inch.
Rajputana and Simla.	Lieut.-Col. G. C. Depree, S.C.	No. 7 ditto - -	Scales of 1 and 6 inches.
Guzerat - -	Major T. T. Carter, S.C.	Guzerat Survey (Trigonometrical Branch).	2 inch scale, for publication on full and half scales.
Kattywar -	Major A. Pullan, S.C.	Kattywar Survey (Trigonometrical Branch).	2 inch scale, for publication on full and half scales.
Kumaun and Garhwal,	Mr. E. C. Ryall -	Kumaun and Garhwal Survey (Trigonometrical Branch).	$\frac{1}{2}$ inch and smaller scales in higher Himalayas.
Mysore - -	Major H. R. Thuillier, R.E.	Mysore Topographical Survey.	1 inch scale.
North Deccan -	Captain E. W. Samuells, S.C.*	10th Revenue Survey	2 inches, for publication on 1 inch scale.

* Since died of fever contracted through toil and exposure in Afghanistan.

Nature and *Locale* of Operations.	Executive Officers.	Old Designation.	Remarks.
South Deccan -	Major H. C. B. Tanner, S.C.	11th Revenue Survey	2 inches, for publication on 1 inch scale.
North-West Provinces.	Major W. H. Wilkins, S.C.	3rd ditto - -	2 inches, for publication on full and half scales.
Muzawar, or Village Survey.			
Trans-Indus and Rawal Pindi.	Col. H. C. Johnstone, C.B., S.C.	1st Revenue Survey -	On 4 and 16 inches scales.
Sirsa - -	Major D. Macdonald, S.C.	2nd ditto - -	On 4 inch scale.
Budaon - -	Captain W. Barron, S.C.	4th ditto - -	Ditto.
Cadastral Survey.			
Banda - -	Col. F. C. Anderson, S.C.	5th Revenue Survey	16 and 4 inches scales survey.
Jaunpur - -	Mr. E. T. S. Johnson	6th ditto - -	Ditto, ditto.
Khurdah Estate	Mr. R. B. Smart	7th ditto - -	32 inch scale.
Soane Irrigation	Major J. Sconce, S.C.	8th ditto - -	Ditto.
Cuttack Irrigation	Captain D. C. Andrew, S.C.	9th ditto - -	Ditto.
Barkagarh and Chota Nagpore.	Captain J. E. Sandeman, S.C.	(Half Party) - -	Ditto.
Miscellaneous.			
Kamrup - -	Mr. W. H. Patterson -	Lakhiraj Holdings Survey.	8 inch scale.
Astronomical.			
Electro-telegraphic determination of Longitude.	Major W. M. Campbell, R.E. Captain W. J. Heaviside, R.E.	No. 1 Extra Trigonometrical. No. 2 ditto - -	In abeyance, because of absence of both officers.
Tidal and Levelling.			
Bombay and Madras.	Captain A. W. Baird, R.E.	Tidal and levelling.	

The operations of some of the survey parties were materially influenced by the failure of the rains in Southern and Central India during the summer of 1876, and the consequent famine. In Mysore two topographical parties of full strength were employed, but it became necessary to withdraw most of the Surveyors from their

duties and depute them as assistants in the Public Works Department, retaining the minimum number on survey operations. Both in Rajputana and Eastern Sind water (always scarce) was almost unattainable during the year, and the Surveyors had to be transferred elsewhere. In several cases work was carried on under much privation and distress, thus causing a general diminution in the outturn of work.

TRIANGULATION.

During the previous season Major Carter, R.E., had extended the principal triangulation of the Madras Coast series from the south to the edge of the great plain of Tanjore, which is commonly known as the Cauvery (Káveri) delta. In spite of heavy rains which turned the country into a vast paddy swamp, the triangulation was carried by Lieutenant-Colonel Branfill over the Cauvery delta and into the valley of the Coleroon river, much obstruction to surveying work being caused by the wooded character of the country and the numerous river channels with which it is intersected. The triangulation spans a direct distance of 39 miles from south-west to north-west, and covers an area of 408 square miles. An approximate connection with the levels of the Southern India Railway was effected, and seven of the old points fixed by Colonel Lambton in the early part of the century were identified. Lieutenant-Colonel Branfill has prepared two interesting papers, which will be published by the Asiatic Society of Bengal, viz., a Note on the physiography of the Cauvery delta, and a list of the proper names of stations and places that appear on the record of the past season's work, with their root meanings, as far as could be gathered on the spot, and a classified statement of those that are characteristic of the country.

For the extension of the Eastern Frontier series southward towards Tavoy it was necessary to have a station on the group of islands known as the Middle Moscos, and another on the Southern Moscos. With the aid of the Government steamer "Ava," these were successfully fixed in a few days by Captain Hill, who then crossed over to the mainland and advanced the series for a distance of 65 miles over an area of 1,748 square miles, exclusive of the area of the triangulation to intersected points, amounting to 1,395 square

miles. Except round Tavoy, the plains and mountains here are alike covered with one uniform mantle of dense forest jungle, clearances being made here and there around villages. Progress was thus a matter of great difficulty, one journey of 32 miles having taken the laden elephants eleven days to cover. The position of the town of Tavoy was fixed, as well as that of the "Three Pagodas," an important work on the Siamese frontier. The party suffered much in health from exposure in these Tenasserim jungles, and from the want of a suitable sanitarium, which appears to be a great desideratum in those regions. Arrangements have been made with the Siamese Government for carrying a chain of triangles eastwards from the vicinity of Tavoy to Bangkok, and this operation, which is so desirable from a geographical point of view, has been since put in hand.

Owing to the failure of the rains, the Eastern Sind party could not work in the desert in which it had to operate, and was transferred to Biluchistan, where the opportunity was taken by the Surveyor General to depute Captain Rogers to carry a secondary triangulation from the western frontier of Sind into Biluchistan, along the line between Jacobabad and Quettah. This triangulation was much needed, in order to rectify the maps of Biluchistan and Southern Afghanistan, in which considerable errors were known to exist. One of Captain Rogers' assistants was sent to carry the triangulation from the side of the Indus series towards the frontier, and others extended the same from Jacobabad towards Quettah *viâ* the Bolan Pass. In the valley there Captain Rogers laid out a small triangulation, and fixed the position and heights of the chief hills. A short base line was also measured there, the latitude of Quettah was determined by astronomical observations, and the longitude by electro-telegraphic determinations from Bombay. Captain Rogers describes the country leading from the Indus valley to the frontier as flat, with a gentle slope upwards to the hills, which rise very abruptly from the plain, presenting an almost inaccessible steeply scarped front, broken up only at the entrance of the Moola Pass. Near the hills there are several considerable villages, notably Gundava and Bagh, and the ruins of many others bear testimony to much greater prosperity and population than at present. The existing state of depopulation is said to be due to three causes,—

failure of water, grinding taxation and oppression on the part of the Khans of Khelat, and forays of the Marris and Bugtis.

A curious formation of clay hills, disposed in ridges, with the scarp facing east, skirts the foot of the northern portion of these hills, and, stretching across the angle formed by the Khelat and Marri hills, into which the Bolan Pass opens, forms the valley of Dadur and boundary of the Sibi plain.

The principal object of the operations in Assam during the present year has been to extend the triangulation of the region between the Subansiri and the Dibong rivers, so as to ascertain which of these two affluents of the Brahmaputra river is most probably the continuation of the Tsanpu river of Tibet. Owing to the fear of collisions with the barbarous tribes beyond the frontier, more than one programme of operations had to be abandoned, but at last sanction was accorded for the Surveyors to go as far as the first high range in the Miri hills, between Subansiri and the Dihang rivers, and also to visit the Mishmi hills, between the Dibong and Brahmakund river.

The detailed results of Lieutenant Harman's measurements of the discharges of the various rivers in these regions will be probably published by the Asiatic Society, to whom they have been made over for publication. They include measurements of the (1) Subansiri, (2) Brahmaputra three miles from Dibrugarh, (3), the united stream of the Dihang and Dibong, as well as (4) the latter separately, (5) the Brahmaputra about nine miles above Sardiya, and (6) the united stream of the Tengapani and Noa Dihang rivers. Broadly speaking, the volume of water in the Dihang river proves to be from twice to three times as great as that of the Subansiri river in different seasons of the year. This proves that, of the two rivers, the Dihang is much more likely to be the continuation of the Tsanpu, though the claim of the Irrawaddy to be the lower course of the latter, formerly advocated by the great Oriental geographer Klaproth, has recently been revived by Mr. Gordon, Civil Engineer of the Department of Public Works in Burma. This interesting point, though almost settled in favour of the identity of the Tsanpu and Brahmaputra by the recent exploration of the former river (*see* p. 79), cannot be truly said to be determined beyond the possibility of all doubt.

Besides the trans-frontier survey work above referred to, a number of new peaks in Bhutan were fixed by Messrs. O'Sullivan and McCarthy, Lieutenant Harman's assistants, as well as other points required to bring the secondary triangulation in Assam to a conclusion.

Mr. H. Beverley, who had charge of the secondary triangulation in Burma, divided his establishment into three detachments. He himself extended a chain of triangles for a distance of 39 miles towards Cape Negrais and Alguada lighthouse, but his further progress was arrested by his being summoned to select suitable sites for two lofty beacons which had to be erected on the mainland abreast of the Krishna, as landmarks to navigators in lieu of the Krishna lighthouse, which so mysteriously disappeared somewhere about August 10th 1878. Mr. Low was prevented by a severe attack of fever from doing more than a little preliminary work towards laying out the triangulation between Thayetmyo and Tounghoo, while Mr. Mitchell, to whom had been entrusted the extension of the Rangoon and coast triangulation towards the Krishna shoal, unfortunately died before performing his allotted task.

Topography.

No. 1 (Gwalior and Central India) party, under Captain C. Strahan, R.E., and Lieutenant Hobday were much hindered in their work by sickness and other causes, but nevertheless completed about 80 per cent. of their proposed outturn, consisting of topography and triangulation in the country about Udeypur, the latter embracing the widest portion and the highest peaks of the Aravali hills. During the current year this party has been engaged on the survey of the Luni river, on the scale of four inches to the mile, this work having become necessary through the transfer of part of this country to our Government under treaty engagements. In course of his triangulation, Lieutenant Hobday visited the Sagwara Pal, a fastness of the Bheels, entrenched, as it were, within a wild bit of country, south of Udeypur. Captain Conolly, of the Bheel Corps, is the only other European who has penetrated this Pal, but owing, no doubt, to the influence of the officers of the Bheel Corps at the neighbouring cantonments of Kherwara and Kotra, the Bheels

showed no opposition to Lieutenant Hobday. Before these corps were organized, these wild tribes believed, and rightly too, that every man's hand was against them and, trusting no man, looked upon all intruders, and even visitors, as enemies, or at any rate a fair prey for robbery. When the regiment was first started the sepoys had to be paid daily, or otherwise they deserted in numbers, simply because they could not believe that if they remained they would receive their pay at the end of the month. Now that they have learned that honour and justice can really be found amongst Englishmen, there are nearly always a number of young men waiting for vacancies to be enlisted in the regiment. Desertions are frequent, but this may be attributed partly to their still imperfect appreciation of discipline and partly to their love of home, which is such that it is no uncommon thing for a sepoy to walk some 15 or 20 miles to his home after his day's work, and be back in time for parade next morning. The inhabitants of the hilly tract around the sources of the Sabarmati are almost all of the Garassia or Naikra tribe, half Rajputs and half Bheels, a people of which the origin is somewhat obscure. Mr. Cornelius, one of Captain Strahan's Surveyors, was informed of a tradition respecting them, which ascribes their origin to the flight and settlement in that tract of a Rajput Chief with his followers at the time that the armies of the Emperors of Delhi were overrunning Rajputana. This Rajput Chief, Ranoojie, settled down, and his followers took to themselves wives of the Ujla tribe of Bheels, and in process of time they became recognized as a separate tribe, and, though not of true Rajput descent, are still allowed on all sides to be far above the Bheels. Unlike the latter they will not eat cattle or nilgai, they are far more civilized in manners, and usually in dress, than the Bheels and Minas; their principal weapon is the bow and arrow. Their houses are built in a peculiar style, the distinguishing feature being that they nearly all have plinths or verandahs, the roofs are of branches closely matted together, and plastered thickly with mud, over which are laid broad coarsely-made tiles; these houses, especially those of the higher classes, have a much neater appearance than the wide bamboo huts of the Bheels.

The plane tabling lay chiefly in a hilly and intricate portion of the Udeypur, or rather Meywar State, the Jargo range, the highest

of the Aravalis, falling within the northernmost of the three sheets operated in. The culminating peak of this range is 4,315 feet above sea level. A very notable feature in the Aravalis is the number of artificial lakes, some of them most picturesquely situated. Four of these lakes receive in their basin the drainage of 1,127 square miles of country; one of them, the Dhebar, which is nine miles by five in extent, is probably the largest artificial lake in the world. The water is but slightly used for irrigation.

Captain Strahan has furnished an interesting description of the various towns and cities within the field of his operations, and of the well known fort of Chittor and its ruins, already described in Todd's "Rajasthan." Capt. Strahan's account is written mainly from a military point of view, and shows that Chittorgarh possesses great advantages as a fortress, the hill itself averaging about 450 feet above the surrounding country, and there being no commanding position within the effective range of modern artillery.

The Khandesh and Bombay Native States Survey (No. 2 party) completed 2,067 square miles of triangulation south of the Tapti, and between the meridians of 74° and 75°, besides detail survey on the 1-inch scale in the Western Satpuras, which Mr. Horst, the chief of the party, describes as lofty plateaux and peaks, the under features of which are very minute, and the greater portion covered with dense jungle. On a larger scale (*i.e.*, 2 inches to the mile) 585 square miles were surveyed, chiefly along the valley of the Tapti, the banks of which are cut up by innumerable ravines. In the eastern part of Khandesh, the soil changes considerably from a rich black soil in the open country to one of gravel in the undulating and hilly portions; irrigation is frequently resorted to by means of wells, which dot the fields, though water is obtainable only at great depths. From an extensive, well-cultivated country, it assumes to the west the appearance of a hilly one, clad with shrubs and trees. Forest reserves of teak, sissu, &c. have been marked off, and further west, approaching the Ghats, are to be found teak, ebony, sál, and other trees; but generally speaking Khandesh is so bare of trees that the collector has ordered the road to be planted with avenues of trees, and encouraged the practice by the promise of rewards and other incitements. He has also imported a large quantity of the babul seed in order to improve the

growth of that tree. In the Western Satpuras, where the plane tabling took place, both water and other supplies were obtainable only with great difficulty. The picturesque plateau of the mountain Turanmal fell within the season's work. This place appeared to Mr. Horst, the surveyor, to be admirably suited for a sanatarium, the summit of the mountain consisting of a series of plateaux, the highest point of which is 3,791 feet above sea level, and the total area about 10 square miles. The same gentleman remarks that in the hilly tracts every available spot in the Native States is cleared and brought under cultivation, but that in the British portion of the Satpuras almost the whole is reserved as forest, and cultivation is rather discouraged than otherwise.

The country triangulated by the Bhopal and Malwa Survey under Captain Wilmer covered an area of 1,865 square miles, and the topography extended over 3,281 square miles, most of which lay in open well cultivated tracts, about two-thirds of it being in the Gwalior territory.

Lieut. R. G. Woodthorpe, R.E., having been deputed for special exploration work north of the Assam valley,* the remainder of the Khasia and Garo Hills Survey, under Major Badgley, proceeded to survey the south-east corner of the Sylhet district, where an area of about 300 square miles was triangulated in marshy, jungly tracts, and some little progress was made in the large scale survey of Shillong.

Owing to the failure of the rains in Central and Southern India, and the consequent drought, it was not feasible to send more than a small portion of the party to Rajputana, the remainder being employed on the large scale surveys of Subathu and Kasanli, and of the road between Simla and Kalka under Colonel Depree's immediate supervision. The detail survey completed in Rajputana covered an area of 1,383 square miles, in parts of Jodhpur and Bickaneer, consisting chiefly in open country covered with low sand hills. For the Simla Survey Colonel Depree elaborated a simple system of surveying within contour lines fixed with the aid of the water-level. A detailed description of this process finds place in the Indian Report for 1877–78. It consists, broadly speaking, of tracing

* See Trans-Himalayan Exploration section, p. 75.

contour lines at vertical intervals of 250 feet by water-level, and sketching four contour lines by eye in each space. The method is described by General Walker as a very valuable one, for it not only furnishes maps which are very much more accurate than any map can pretend to be which has no true contour lines, but when once the principal contour levels have been demarcated on the ground by bench marks set up at convenient intervals, they can be followed and laid down mechanically on the plane tables by men who might be incapable of drawing a single feature of the hills they are surveying.

The Mysore party, which represented the aggregate strength of Nos. 8 and 9 parties, after deducting 16 surveyors, &c. who had been temporarily transferred to the Public Works Department for employment on famine relief works, carried triangulation over 2,813 square miles, and topography over 2,375 square miles, in country of a varied nature. By the season's operations four standard sheets of 30′ in longitude and 15′ in latitude have been made available in a preliminary form, and a fifth is nearly complete. Major Thuillier, the chief of the party, reports that on taking the field the prospects were better than could be expected, considering all the trials to which the province had lately been subjected. The tanks were filled, pasturage was abundant, and but for the deserted look of the villages, a stranger could not have imagined that famine and drought had been so lately devastating the province. Nevertheless fever was very prevalent, and with the exception of the officer in charge, no single member of the European portion of the party escaped it. The state of Mysore occupies a position which has been not inaptly described as a rocky triangle, situated in a triangle where the Eastern and Western Ghats converge into the group of the Nilgiri hills west, south, and east; it is thus enclosed by chains of mountains, on whose shoulders the plateau which constitutes the country rests. The general elevation rises from about 2,000 feet above sea level along the northern and southern frontier to about 3,000 feet along the central waterparting, which separates the basin of the Krishna from that of the Cauvery, and divides the country in two nearly equal halves. But the face of the country is far from even, being everywhere undulating, much broken up by rocky hills and mountains, and scored in all parts by deep ravines. "The country is "longitudinally intersected by single or aggregated chains of hills

"running chiefly north and south and at unequal distances from "each other, and accordingly forming sometimes wide and sometimes "narrow valleys. Isolated massy rocks, termed by Europeans "*droogs*, rearing their heads to 4,000 or 5,000 feet above sea "level, stand forth like sentinels on every hand, mostly crowned "with the remains of fortifications, whose position, with the advan- "tage of an unfailing supply of water at the summit, rendered them "well nigh impregnable. Besides these, clusters of piles of hacked "rocks, composed of immense rounded boulders are frequent, large "fragments being often so delicately poised that a touch would "apparently overturn them, and yet sometimes supporting a shrine "or mandapa."* One of the chief features for which Mysore is famous is the number of tanks it contains. These run in "series," and are formed by embankments thrown across a valley at favourable points, the outflow from each tank supplying the one below it. They vary considerably in size, increasing towards the bottom of the series where they often form large lakes. The lowlands are irrigated mainly by these tanks, which number above 37,000. During the current season the party will extend the triangulation over degree Sheets VI. and X. The western portion of this is necessary, with a view to the settlement of the boundary of the province on that side with South Canara.

The operations of the Guzerat survey, nearly the whole of the year, were conducted by Major Carter, and here, although the health of the men of the native establishments is said to have been very bad from the effects of the famine, a satisfactory out-turn of 1,820 square miles, on the scale of 2 inches to the mile, was surveyed in the Ahmedabad, Kaira, and Panch Mahals collectorates and in the Baroda state, and the Mahikanta and Rewakanta political agencies. An area of 68 square miles of forest tract of Dangs was also surveyed on the scale of 4 miles to the inch, but owing to the density of the forest growth, the details of the ground had to be put in on the plane tables by chain traversing instead of sketching in the usual manner, which made the work very tedious; the cost of the difference of scale being partly defrayed by a grant of Rs. 30,000 from the Forest Department budget. An area of 2,130 square miles was also triangulated and traversed in advance. In the tracts surveyed by Mr. Bond, about 50 miles north-east of Ahmedabad, he fell in

* Gazetteer of Mysore.

with a class of Bheels who are professional robbers called Garasias. Tigers and leopards were frequently met in the hills. One of the most remarkable features of the country is an extensive sheet of water in a hollow called the Bokh, which was originally bed of the Hathmati river, from which the stream was diverted by the construction of a dam into its present course by Sultan Ahmed Shah, the founder of Ahmedabad, his object being to increase the volume of the Sabarmati river, on the banks of which he had just founded his new city.

In Kattywar the political agent, in September, anticipated a famine, but fortunately some heavy showers fell in October, and, although the people suffered from scarcity, there was no absolute famine. This enabled the Kattywar survey, under Major Pullan, to take the field, though a proposal for surveying the intricate and wild tract of hills known as the Gir had to be abandoned, owing to the streams there being dried up. An out-turn of 2,019 square miles was completed on the scale of 2 inches to the mile; and, in addition to this detailed work, an area of 2,180 square miles was triangulated as a basis for future topography. Part of these operations lay along the seashore, from Porbandar towards Mangrol, which is rocky, of limestone formation, and in many places presenting a honeycombed pavement of limestone, with low ridges running along the coast covered with cactus bushes. The soil, in a great measure, is a rich black earth, which produces good crops of cotton, jowari, bajri, and sugar cane, and in some parts wheat, turmeric, &c. Owing, however, to the scanty rainfall this season no cotton was grown and other crops were meagre. Mr. McGill, Major Pullan's assistant, speaks highly of the intelligence and patient toil of the people, who during this season of scarcity erected "motes" or stages for leather water bags for raising water from the streams in localities where wells had failed, and so irrigated their parched lands. The country skirting the Gir is undulating, and covered with dense low jungle, but here land is being fast reclaimed from the Gir forest; little villages are springing up with patches of cultivation round them, and the ring of the axe tells of the steady advance of civilisation into this jungly and malarious tract, the haunt of the lion and panther. Gumli, a ruined city with old and graceful temples and tanks now falling to decay, lying

north of the Barda hills, fell within the area of survey. This place was in times past the residence of the Jetwa Rajput chiefs, who at one time ruled over half of Kattywar, their territory stretching from the Rann of Cutch to the southern coast. The lineal descendant of these chiefs is now the Rana of Porbandar, but his territory has been reduced to a small strip of territory along the western coast, called Barda. Porbandar has a population of 14,500, and a number of wealthy merchants of the Bhatia and Bania castes. It has a very fine port for country craft, and carries on a thriving trade with the Persian Gulf and Indian Ports. Its chief exports are grain, ghee, and slabs of white limestone for building purposes. Mr. McGill furnishes a brief description of the chief towns, rivers, &c. in Western Kattywar, which should prove most useful for purposes of reference. No good timber trees are to be seen in this region, and most of the trees that are found grow in small quantities. The date palm grows luxuriantly on the borders of some of the smaller rivers, but the people never tap the trees for toddy, and the only use they are put to is for making brooms from the leaves. Iron ore is found in many parts of Garda and Hallar. The bullocks are here inferior to those met with in other parts of the country; cows and buffaloes are numerous, and some of the larger are much valued for the quantity of milk they yield. Sheep of a large breed, and generally white, are seen in flocks of 100 and upwards grazing in the waste lands of every village. Of wild animals the lion (sawaj), the panther, jackal, fox, and wild cat are found in the Gir, as also the sambur, nilgai, and chital; the common red antelope (gazelle?) and black buck are seen in herds almost everywhere. The tanks are in most places full of duck, snipe, and other game, and the common partridge lurks in the village hedges, and the quail in every field. Wild hogs are seen in abundance in the Gir and other woody spots. Along the sea coast and in creeks the flamingo, curlew, and gull may be seen in flocks mingled with spoonbills, ibis, and other birds.

The field operations connected with the topographical survey of Kumaon and Garhwal having been brought to a conclusion, the work of this party was almost entirely confined to office duties connected with the preparation of the maps. Owing to certain discrepancies met with in attempting to combine this work with

that of the North-west Himalayas Series in 1852, when a rough topographical sketch of the hill ranges on the scale of 2 inches to the mile was executed in addition to the triangulation, considerable discrepancies were met with, as well as a blank of several square miles still remaining for survey at the head of the valley of Gangotri. Mr. Kinney was therefore sent to revise the old work and to survey the blank in question, as well as to make a geographical reconnaissance of western Hundes, northward of his field of operations, which Mr. Ryall had not time to visit in the course of his operations during the previous year. Mr. Kinney has performed all this work very satisfactorily, and his report, as well as Mr. Ryall's interesting paper on Hundes, will be found in the Trans-Himalayan section (pp. 65 *et seq.*). Mr. Ryall has also compiled a new map of the country, which, while containing sundry rectifications of the detailed portions of the map executed by the brothers Strachey, is at the same time a proof of the skill and general accuracy with which their rapid reconnaissance was made.

Tidal and Levelling Operations.

During the year Captain A. W. Baird, R.E., the officer charged with the supervision of Indian tidal observations, visited Bombay, Kurrachee, Carwar, Aden, Beypore, Paumben, Madras, and Vizagapatam, and at each of these ports, with the exception of the two last, satisfactory arrangements were made for the institution of accurate tidal observations. At each port a man is appointed and paid by the port authorities to take charge of the instruments, and is instructed in their manipulation. A report showing the value of the tidal height for each hour is sent off to Captain Baird daily by post, to whom will fall the duty of calculating the tidal elements for each port from his own tidal registers, as soon as they have been carried over a sufficient period to furnish the requisite data. Those for Bombay have been already deduced; when once the tidal elements for any place have been determined, curves representing the momentary variations in the height of the sea level during any required period, past or future, may be readily constructed graphically with the aid of a tide calculating machine. The value of such a machine in reducing labour of computation is so great

that the Secretary of State has sanctioned the construction of an improved one specially for use in India, which has just been completed by Mr. E. Roberts, of the Nautical Almanac Office.

In connection with the tidal observations are being carried on spirit-levelling operations, partly with a view to connect the tidal stations, and ascertain whether there is any appreciable difference of level in the mean sea level at the several places, and partly to connect together and reduce to a common datum the several hitherto isolated systems of levels which have been executed throughout the country for canals, railways, and other engineering works. Double lines of levels, executed independently by two persons, are carried over the country from one tidal station to another, fixing new bench marks and connecting with the bench marks of other systems of levels. During the year lines have been carried from Damaun to Bombay, connecting the three tidal stations in the Gulf of Cutch with the one at Bombay; from Bombay to Callian Junction of the Great Indian Peninsula Railway, and thence up the Bhore Ghat to Poona and down to Satara; from Callian to the Thal Ghat, and thence up the Ghat to Igutpuri, Malegaon, and finally to Chikhalwohol. In addition to these main lines short branch lines were carried to connect local bench marks of importance. The aggregate length of line completed amounts to 589 miles, fixing 536 bench marks.

The Head Quarters' Offices.

The five Survey Head Quarters' Offices in Calcutta, viz., the Surveyor-General's, the Lithographic, Photographic, Mathematical Instrument, and Revenue Survey Offices, are still in separate buildings, and great inconvenience is felt thereat, but a suitable site has been purchased for the construction of a set of buildings to contain the whole of the offices in one spot.

In the Surveyor-General's Office, Captain E. H. Steel has been officiating in lieu of Mr. J. O. N. James, who, after 19 years of assiduous service, has proceeded to this country on furlough. Owing to the great increase of work in preparing maps and data for other departments, a separate examining branch has been formed under Mr. A. Chamarett, a surveyor of considerable and varied

experience. Good progress has been made in the drawing branch, the chief maps in hand being the new edition of the map of India on the 32 mile scale, and various provincial maps on the 16 mile scale. The engraving branch has been occupied with two classes of work, viz., the sheets of the Indian Atlas, on the scale 1 inch to 4 miles, and provincial and other maps on smaller scales. Eleven atlas plates were completed, 41 new ones are in hand, and additions and corrections, some of an extensive character, were made to 19 old plates. Six other engraved maps are also in various stages of progress, while among the miscellaneous work completed may be mentioned an excellent map of Colombo Harbour for the Marine Survey Department. General Walker reports that the engraving office now contains a large number of natives who have been trained to engrave names and outlines, and generally to perform all the more mechanical work very satisfactorily. "But," he adds, "it "appears improbable that natives will attain the degree of artistic "skill which is required for all hill-etching, with the exception of "what may be done by closely imitating a good original, line by "line. To produce a good etching in lines from a drawing in "brush-work, to translate contoured lines into vertical hachures, or "to give a correct delineation of the orography of a country on a "small-scale map by reduction from a large scale survey, requires "qualifications which are possessed by only a few of our Euro-"peans, and which are scarcely to be expected of the natives of "this country." This will prove disappointing to expectations which have been generally formed that the natives would eventually be able to take up a large proportion, if not all, of the engraving work, which, owing to the large salaries drawn by the European engravers, is at present of so expensive a character. However, it may be remarked that the question is not as yet settled.

The issues of maps have much increased during the year, mainly owing to the publication of a catalogue. The total number issued was 20,869, value 3,090*l*. The value of the total stock of maps in the office is 44,987*l*., and the amount realized by the sales to private individuals and map agents during the year was 782*l*.

The lithographic branch printed 162,913 copies of maps, plans, and diagrams during the year; some of these for other departments, such as the archæological and geological surveys being of an

elaborate character. In the photographic branch the out-turn of work showed a great increase over that of former years. The arrangements for the reproduction of the cadastral plans of the North-west Provinces are now complete, and it is anticipated that between 4,000 and 5,000 sheets will be struck off during the current year, besides a large number of impressions of maps of the Bengal Cadastral Surveys, on the scale of 32 miles to the inch. During the summer and autumn Captain J. Waterhouse, the head of the photographic and lithographic branches, made an interesting tour of inspection of most of the principal cartographical establishments of London, Paris (including the Exhibition), and Vienna and acquired a variety of useful information respecting the latest processes and methods of reproducing maps. He succeeded in securing for the office the right of using Mr. Willis's new platinotype process, which promises to be a very perfect substitute for silver printing, with the great advantage of producing permanent prints, and he also ascertained full details respecting the new process of *heliogravure* as practised at the Vienna Military Geographical Institute.

The Mathematical Instrument Office receives all instruments of European construction sent out for the Indian Survey, constructs the less elaborate ones, executes necessary repairs, and keeps a stock of serviceable instruments for survey and other scientific purposes for issue to the Survey and other departments in the Bengal Presidency. These other departments consist of, first, the Public Works Department, and then, in a less degree, of the Forest, Educational, Marine, Meteorological, and general Civil Departments. The figures show that only about a third of the expenditure of the Mathematical Instrument Office is fairly debitable against the Survey Department.

In the Trigonometrical Survey Office at Dehra Dun much valuable work has been done during the year under the able superintendence of Mr. Hennessey. Shortly after the close of the period under review, Volume II. of the account of the operations of the Great Trigonometrical Survey was completed; Volumes III. and IV. had been finished some time previously, but detained for the intermediate volume. The account of the pendulum operations has been delayed, partly because there was a difficulty and delay in getting the necessary type, and partly because Major Herschell has

urged that the volume on pendulum operations in India should contain not only the reduction of the Indian pendulum swings *per se*, but also the actual application of these observations to investigations of the figure of the earth, and of the constitution of the earth's crust. This proposal has been supported by the Royal Society and will naturally, if conceded, enlarge materially the scope of the volume.

The chief work of the Drawing Branch has been the preparation of the fourth edition of the map of Turkestan, embodying all the new information which has been acquired both on the side of India and Russia since 1875, when the last edition of the map was published. This map is expected to be available for issue very shortly*. A map of Afghanistan enlarged from the third edition of the Turkestan map, with such corrections and additions as were immediately needed, was prepared in about a week, and several hundred copies supplied for the use of the army in Afghanistan.

Revenue Surveys.

During the year under review there were 11 full strength and two small Revenue Survey parties at work in the Punjab, North-western Provinces, Bengal, Bombay, and Assam. The out-turn of the Cadastral Surveys, on the scales of 16 and 32 inches to the mile, was 421,111 acres completed in detail, and 376 square miles of which the village boundaries were surveyed in advance, while of the ordinary village and topographical surveys, on scales varying from 4 to 1 inch to the mile, 10, 3, and 2 square miles were surveyed in detail, 6,003 square miles surveyed (as far as the village boundaries are concerned), and 4,347 square miles triangulated in advance. The total out-turn of detail survey during the season thus amounted to 11,872 square miles, apart from the areas triangulated and traversed in advance.

Major-General Johnstone's party surveyed a total out-turn of 4,676 square miles of triangulation and village boundary survey, and 1,857 square miles of detail survey in the Dera Ismail Khan, Bannu, and Rawalpindi districts, and in the Jowaki country an independent hill tract between Peshawur and Kohat. The area completed in detail was surveyed on the scale of 4 inches to the

* This map has recently reached England. It is a most complete and interesting production.

mile, with the exception of 57 square miles in the neighbourhood of Edwardesabad, which was done on the scale of 16 inches to the mile, to show the intricate system of irrigation. Connection was effected with numerous stations of the Great Trigonometrical Survey, and the average error of the Revenue Survey measurements, as compared with those of the great triangulation, was as little as 2·44 feet per mile. General Johnstone reports that, as a rule, the *thakbust* or settlement boundary maps of Bannu and Dera Ismail Khan districts were good, and agreed well with the professionally surveyed boundaries, but those of the hilly portions of the Rawal Pindi District were, as might have been expected, somewhat indifferent. The season saw the retirement of General Johnstone, of whom General Vanrenen, Deputy Surveyor General and Superintendent of Revenue Surveys, reports as follows, "His long and "useful services extend over a period of 25 years, for 23 years of "which he has held charge of a survey. The Department loses in "him a talented, able officer, and the Government a very tried "experienced servant, whom it will find difficult to replace in the "Punjab, as his knowledge of the frontier, and the tribes occupying "it, rendered his services to the Government especially valuable."

Captain E. H. Steel and (subsequently) Major D. Macdonald had charge of the Sirsa district survey, on the scale of 4 inches to the mile, and rendered a total out-turn of 1,794 square miles, including an overlap into the district Hissar and the Patiala and Bikanir States. The village was the unit of survey, and all details, such as cultivated fallow and culturable land, village boundaries and sites, markets, roads, paths, buildings, &c., were carefully mapped. On the whole the district is easy country to survey, but near the Gaggar and other rivers subject to inundation, the details of cultivation, &c. are very intricate and require careful examination. Another obstacle to rapid progress in well cultivated parts is the drifting sand which pervades the whole district and obliterates the land marks. It is often very difficult to say where the cultivation ends, and the surveyor is in a great measure dependent on the villagers for this information. Portions of Sirsa, which to an ordinary traveller would appear nothing but sandy waste, is often a mass of cultivation. The barley, one of the principal *rabi* crops, may be seen all over the district, forcing its way up through several inches of drift sand. The accuracy of the detail survey was tested

by 525 linear miles of check survey, and the traverse survey was connected with 19 principal and secondary stations of the Great Trigonometrical Survey. The angular work was tested by 31 azimuth observations, taken at an average distance of 13 miles along the main circuits.

The 14th or Ganges Dearah Survey, on completing its assigned work in Bengal, was transferred to the North-west Provinces for the survey of district of Saharanpur. Owing to the decision of Government that those districts of the North-west Provinces which did not require to be surveyed cadastrally should be surveyed merely topographically, on the scale of 2 inches to a mile, showing in addition the pargana boundaries, instructions were given to Major Wilkins that the survey was not intended as a check upon the settlement operations, that therefore it would be unnecessary to crowd into the interior survey minute details of cultivation, culturable waste or jungle lands, and that all that was needed was a good topographical delineation of the country up to the scale of survey, *i.e.*, that the survey should include large patches of waste, barren as well as culturable, the general outlines of cultivation, tracts of jungle, limits of forest reserves, roads, drainage in all its ramifications, tanks, village sites, temples, embankments, &c.; in short, the same details that are required in the usual village by village (4 inches to the mile) survey, but *generalised*. The final maps of the Saharanpur district (of which the present season's work comprises 10) will include 24 sheets. The total area of the district is 2,288 square miles, of which 850 have been completed, and 378 has been taken up by the Forest Survey, on the scale of 4 inches to the mile.

The Budaun District Survey was completed by Captain W. Barrow's party, the survey being merely for topographical purposes, but on the same scale (4 inches to the mile), and partaking of the nature of an ordinary *mauzawar* or village survey. The party will next survey cadastrally the Ghazipur district.

The Banda District Survey finally completed 725 square miles of country, 606 being cadastrally surveyed on the 16-inch scale, and 119 topographically on the 4-inch scale. The next destination of the party will be Mirzapur district. A cadastral survey party, under Mr. E. T. Johnson, was employed in the Jaunpur district, where

there is an extensive area of about 1,400 square miles left for completion; another, under Mr. J. Campbell, *vice* Captain Andrew transferred to Cuttack, was engaged in revising and completing the cadastral records of districts Agra and Hamirpur; and another, under Mr. R. B. Smart, was occupied in a survey of the Khorda Government estate, district Pooree, on the large scale of 32 inches to the mile, a scale rendered necessary by the small size of the fields, which averaged a-piece only third of an acre in area. Great inconvenience appears to have been felt during the year under review (as well as in the two preceding years) owing to the defective demarcations of the fields in the tract under survey.

In the Shahabad and Patna (Eastern and Western Soane) districts a total area of 394 square miles was surveyed cadastrally by Major Sconce's party, on the scale of 32 inches to the mile, except a small portion of non-irrigable ground which was surveyed on the 4-inch scale. At the request of the Irrigation Department a party under Captain D. C. Andrew was got together to survey the irrigable lands of Cuttack, amounting to a total area of 465 square miles, but owing chiefly to the inexperience of the natives progress was small. Another party under Captain Sandaman was engaged in the Barkagarhand Chota Nagpore Estates Survey, where 151 square miles were surveyed on the 16-inch scale. Here the absence of a single permanently marked point or station throughout the whole of the area of operations will eventually, General Vanrenen considers, cause much inconvenience, even the theodolite stations being marked by burnt clay cylinders.

In the Bombay Presidency, the 10th party of the Revenue Survey Branch, under Captain E. W. Samuells, was engaged (on what are usually called the Deccan Topographical Surveys) in the Poona and Ahmednagar districts. The area surveyed in detail amounted to 2,090 square miles, and triangulation extended over 2,525 square miles in advance, the scale being 2 inches to the mile. A careful comparison was made between the village boundaries surveyed and those of the Bombay Settlement maps, and the result showed that on level ground the two surveys agree very well, but in the hilly portions, and especially near the Ghats, the settlement maps could not possibly be utilised. Owing to the failure of the usual rains in 1876, the prices of grain of all kinds remained very high

throughout the season under review, and though there was no actual scarcity there was a good deal of distress here and there. Captain Samuells describes the general aspect of the localities traversed as undulating grass-covered ridges and ranges of hills without trees or forest of any kind, only cactus, scrub, or prickly pear here and there. The geological formation is volcanic, and consists of alternate strata of amygdaloid and basalt. The country at one time and another has been flooded by successive waves of lava. Many different eruptions may have occurred to form the present visible portion of the district, and these probably took place at long intervals, during which the amygdaloid underwent disintegrating influences, but the basalt being harder withstood it better. Thus the level table lands of the hills and the perpendicular cliffs are composed of basalt, while the irregular slopes consist of the softer amygdaloid. The villages are, as a rule, situated in the valleys, compactly built and surrounded by a bastioned wall with gateways. There is generally some garden land in the vicinity of the villages adjoining the banks of streams, either watered from wells or from the stream itself by means of *bandharas* or earthern embankments. Fine mango and tamarind trees are often seen, which help to redeem the otherwise desolate appearance of the country. Several hill forts are dotted about the country, some situated on isolated hills, others on the bare plain itself, but more frequently on the higher spurs and ranges, where some hardened portion of basalt has undergone a disintegrating process and formed an almost ready-made fortress. The drainage from the Ghats is all to the east, the rivers all flowing across the Peninsula into the Bay of Bengal. The enormous rainfall that breaks on these Ghâts during the south-west monsoons has worn deep precipitous valleys, which have eaten their way back to the very watershed, leaving flat-topped spurs between them, which stretch far out into the Deccan, forming the watersheds. The hill ranges and spurs, though flat and undulating on top, are cut up and intersected by very deep *khads* or ravines, as owing to the tremendous rainfall every small watercourse cuts a deep channel for itself. In some places the heads of these ravines nearly meet, leaving only a narrow neck of land just wide enough for the road. The forest and jungle that once covered these Ghats have been almost entirely destroyed, here and there a clump has been left round an old temple sufficient

to show what it must once have been. Magnificent large trees, chiefly mango and jamun or jambul, festooned with enormous creepers, grow as luxuriantly as in any forest in Assam or Central India. Besides these few clumps there is nothing that can be called forest; here and there on the edge of the Ghats there is dense scrub jungle, but no trees, and in consequence of the jungle being destroyed, the heavy rainfall has washed away the soil, so that it will be some considerable time before it can again support forest.

When the British took possession of the country much of it was nearly ruined, and since the famine of 1803 a great part had been almost entirely uninhabited. As examples it may be enough to state that in 1803 only 21 villages out of 180 were inhabited in the Newasa taluka. In other parts of the same collectorate in 1819 more than half the land was waste, and the country round Sirur was all jungle. The city of Ahmednagar contained in 1819 a population of 13,000, and in three years the number was almost doubled; it now contains 30,000 inhabitants, and the lands around are of considerable fertility and well watered.

In most of the large towns there are looms for the manufacture of coarse cotton cloths, and the Dhangars weave blankets, the wool being obtained from the sheep of district. In Ahmednagar and the neighbouring town of Bhingar there are about 1,400 looms kept at work in the manufacture of *saris* and other cotton cloths. Some of these are of a superior description, and have an edging of coloured silk, or are made half of silk and half of cotton. The raw silk is imported from China to Bombay, and bought in Bombay by the local merchants at about Rs. 9 a pound. No country silk is used, although its cost would be about half that of the China variety. The silk is spun into thread, dyed by the sowcars, and sold to the weavers, who mix it with the cotton thread or weave into edgings for *saris* and *langotis*. An attempt was made many years ago, in 1840, to rear silkworms by a Major Byne, who rented the ground from Government, and planted a number of mulberry trees. The trees flourished and are there still, but the experiment did not pay and it was given up. There is a large manufacture of brass cooking utensils in Nagar, and in Kurdah there are about 125 families of weavers who manufacture coarse cotton stuffs, chiefly from country thread.

The 11th party, under Major H. C. B. Tanner, completed an area of 2,423 square miles in detail, and triangulated in advance an area of 1,620 square miles, their work being mostly in the Eastern Talukas, adjoining the territories of the Nizam. The Bombay Revenue Survey maps were turned to tolerably good account, Major Tanner having been enabled to utilise the topography of about two maps out of every three, while he anticipates that as they work southward this proportion will improve. The following is his description of the way in which these maps were utilised:—

"The system we found to answer best is simply, first, to test the exterior limits of the village plan by measurements taken from our plots, and then should the error be small to put it on a plane table and complete the topography, setting up the table on the trijunction of fields, and either intersecting the required items or measuring them with off-set rods. The information thus obtained is entered in red on the village plan, and the whole is then reduced with a pentagraph. . . . . It is found that such items as touch the boundaries of fields are almost invariably correct, and only such as fall within the field itself are liable to error. In the case of hilly and rough ground we reject the Bombay plans and survey the tract ourselves."

During 1878–79 the work of this party will progress southwards in districts Sholapur and Satara.

In Assam a small Revenue Survey party under Mr. W. H. Patterson was engaged on a lakhiraj survey in Kamrup district, the work of which consists of three operations, viz., the professional survey of interior details, the adjustment of areas and boundary, and the final demarcation and boundary survey. It is anticipated that the work in district Kamrup will be completed in 1881–82.

Geological Survey of India, 1878.

The most important geological event of the year has been the issue of the "Manual of the Geology of India," by Messrs. H. B. Medlicott (Superintendent) and W. T. Blanford (Deputy Superintendent) of the Geological Survey. This important work is contained in two volumes, aggregating some 900 pages, and is accompanied by a preliminary sketch map on the scale of 64 miles to an inch, and a score of plates. As a general account of Indian geology it supplies a want felt for some years. Owing to the facts that the published Memoirs and Records of the Survey had become too numerous and bulky for general use, and that many papers on Indian geology were scattered through various Indian and European periodicals, while many other recorded observations were unpublished, a compendium of all the existing literature became an absolute necessity.

The work opens with an introduction in which the general physical geography of India is explained, as well as its threefold division into Peninsular India, the extra-Peninsular area, and the Great Indo-Gangetic alluvial plain.

The first volume, treating of the so-called peninsular areas, deals with the following formations in succession: the Gneissic or Metamorphic, the Sub-metamorphic, and the Vindhyan series, the Gondwana systems (including details of coal-fields), the Marine jurassic rocks, the Deccan trap series, the tertiary rocks, and laterite or iron clay and lithomarge. Three concluding chapters in the same volume describe the post-tertiary and recent formations.

The second volume deals with the extra-peninsular area. It commences with Sind, proceeds to describe the Punjab Hills west of the Jhelum, and then takes up the subject of the Himalayas, dividing these into three zones, viz., the Sub, Lower, and Central or Tibetan Himalayas. A special chapter is devoted to the subject of the Siwalik fauna, and the last two describe the Assam range and Burma.

Although previous summaries of Indian geology are not wanting, viz., those of Calder (1838), Newbold (1844–50), and Dr. Carter (1854), the authors of these laboured under the serious disadvantage of a more or less partial knowledge of the vast subject with which they attempted to grapple. And although the geological examina-

tion of our Indian Empire is as yet far from complete, still so much has been achieved by the work of the Survey, which may be said to have commenced in 1851, that the mass of recorded observations forms now an incomparably richer stock of materials than anything available in those days. The present work, therefore, will not only prove very valuable on account of the positive information it affords, but also because it will form a distinct datum line whence to rate future progress.

During the year (1878) Mr. Hacket examined a very large area of azoic rocks at the northern extremity of the Arvali range, and his researches suggest some simplification of the views previously entertained respecting the stratigraphical conditions of the series. A description, with maps, of the hitherto unsurveyed basin of Palamow, has been published by Mr. V. Ball in the Memoirs. The ground is more accessible from the trunk railway than the coal basins of the Upper Damuda valley, and projects for working the coal have lately been proposed. Two new coal-fields have been marked in the basin of the Koel river, with areas of 97 and 78 square miles, but, so far as could be determined from surface indications, the coal of these areas is not so good as that of the smaller Daltonganj field lower down the Koel to the north. The geological interest of this ground is that here a marked change takes place in the petrological characters of the Gondwana system between the series, as developed in the Damuda valley coal-fields, and that found in the great midland area of South Rewah (the Son region) as well as in the Mahanadi and Godavari regions. Other points in the elucidation of the Gondwana system were investigated by Mr. King on the Lower Godavari, and Mr. Hughes working from the north towards the Wardha coal basin. Early in the season Dr. Feistmantel visited the Satpura coal basin to examine on the ground some good sections of the Gondwana series, the flora of which he has been closely studying. The coal measures of those fields were always taken to represent Barakars, the lowest Damuda coal measures, and Dr. Feistmantel has shown that they belong rather to that still lower horizon of coal-bearing strata represented by the Karharbari measures in Bengal.

To the west, where the Gondwanas become associated with marine strata, Mr. Fedden broke new ground in Kattywar, where he surveyed about 1,800 square miles, deriving in the course of his

work much assistance from the excellent sheets of the Topographical Survey. The country is mostly flat, and the rocks consist of Deccan traps, overlying sandstone, in which some remains of plants were found, proving that a portion of the least of the Cutch jurassic series extend into Northern Kattywar.

In Southern India Mr. Foote took up new ground to the south of Trichinopoly, and in crossing the cretaceous area made some valuable additions to our fossil collections from those formations. A re-examination of the locality where the Utatur plants occur at the base of the series, and arrived at the conclusion that these plant-beds are marine. South of Tanjore the country has so far proved very uninteresting; no rock appearing between the gneiss and the coast alluvium, except the Cuddalore sandstone formation intimately blended with the super-imposed laterite.

In Hazara, in the North-western Punjab, Mr. Wynne made a preliminary examination of some new ground, and defined the limit of the crystalline rocks forming the higher mountains, besides tentatively classifying the unaltered sedimentary series south of the gneissic area. One indication resulting from his observations seems to point to the gneiss of Hazara being much newer than the central gneiss of the Himalayas. Mr. Lydekker spent the season in the mountains of Dras and Tilail, where he has described some important sections of the sedimentary rocks. Colonel McMahon has made an important contribution to the geological knowledge of the Himalayas in his observations of the relations of the limestone and strata series of the Lower Himalayas to the central gneiss, and in his re-affirmation of Stoliczka's original identification of the Krol limestone with the Lilang limestone of Spiti. Mr. Theobald made some large additions to the collections of the Siwalik fauna, the results of which are duly recorded in Mr. Lydekker's papers in the Records and Palæontologia Indica. Mr. Theobald has since been engaged upon the tertiary zone, east of the Ganges, in Rohilkhand, at the foot of the Himalayas of Garhwal and Kumaun. Mr. Mallet investigated some coal seams in Ramri Island, which, however, offer but little promise.

Mr. H. B. Medlicott, the Superintendent, was chiefly occupied in directing the work of the survey and editing the publications, but he also made a short trip to the North-west Provinces to assist in

inquiring into the causes of deterioration of land by *reh* in the Aligarh district, and states that he was strongly impressed with the extensive injury to cultivation to be apprehended from *reh* in connexion with canal irrigation in the excessive climate of North-western India. Mr. Medlicott took the opportunity to investigate two reports of supposed discovery of coal in the Siwalikhs of Dehra and in the same rocks of Nahan, both of which proved illusory.

In the "Memoir on the Indian Surveys" (2nd Edition), through inadvertence, little or no mention was made of the services of Mr. Vincent Ball, M.A., F.G.S., of the Indian Geological Survey, who has done much hard and useful work in that department. Mr. Ball was appointed to the Geological Survey of India on the 29th October 1864, and in the following season surveyed the Ramgurh coal-field, notes on which were duly published by him in the "Memoirs," Vol. VI. Mr. Ball was next engaged in the survey of Manbhum and Singhbhum, which occupied several seasons, and reports on which districts (with special reference to their copper and gold deposits) appeared in the "Records." Since 1870 Mr. Ball has been largely employed, at different times, in researches into the coal measures of various localities, viz., the Chopa and other previously unknown fields in Western Chutia Nagpur, the Bisrampur field in Sirguja, the Luni Pathan country in Afghanistan, and the Raigurh and Hugir fields in Sambalpur. Mr. Ball also accompanied Mr. Bauerman in 1872–3 in his inspection of the principal coal and iron deposits of Bengal and the Central Provinces, and in 1875–6 reported on the value of the Orissa coal-fields and on the diamond-bearing rocks of Sambalpur. In 1876–7 Mr. Ball explored a wild region between the Mahanadi and the Godavari, the result of which was to reclaim from the *terra incognita* of the geological map an area of about 30,000 square miles. The following season was taken up with examination of the coal-fields of Aurunga Hutar and the iron deposits of Palamow.

Mr. Ball is at present occupied in passing through the press an important work entitled "Jungle Life in India," in which, in addition to popular sketches of his geological work, he gives his observations on the zoology and ethnology of the numerous and varied localities in India (as well as the Andaman and Nicobar islands) visited by him. An interesting paper published by Mr. Ball last year in the Proceedings of the Royal Irish Academy

furnished a resumé of all that had been recorded regarding ancient stone implements under the title of "On the geographical distribution of ancient stone implements in India."

The only number of the Memoirs (the price of which publication has been reduced) issued during the year was Mr. Ball's report (with three maps) on the Palamow coal-fields. On the other hand, the Records are much fuller of matter than usual, extending to three times the size originally contemplated, and containing numerous outline maps. Of the Palæontologia Indica were issued during the year, one by Dr. Feistmantel on the flora of the Jabalpur group, and one by Mr. Lydekker on the crania of fossil ruminants.

In the Museum fair progress has been made in the arrangement and labelling of the various collections.

The personnel suffered by the death of Mr. W. L. Willson, who joined the service from the Geological Survey of Ireland in March 1857. He has been succeeded by Mr. C. L. Griesbach, who has been deputed for the present to examine the Gondwana rocks in the Sone region, in continuation of Mr. Ball's survey of Palamow.

Archæological Surveys of India.

During the past year Volumes VII. and VIII. of the series of Reports of the Archæological Survey of India, published under the superintendence of Major-General A. Cunningham, C.S.I., C.I.E., have been issued. Both are by his assistant, Mr. J D. Beglar. The former describes two tours, viz., in 1871–72, over the greater part of Bundelkhand and the north-eastern portions of Malwa, and in 1873–74 over the eastern half of the Central Provinces.

Starting from Delhi in the first of these two seasons Mr. Beglar travelled southwards to Mathura (Muttra), Agra, the remains of which are numerous, and have been described by Mr. Carleylle and others, and Bateswar, whence he traversed the tract in Sindia's territory south of the Jamna, and between the ravines of the Sind, Pahoj, and Chambal rivers. Of this region he remarks that, so far as the remains of monuments and structures enable one to judge, it was never so prosperous as now. Its rise in wealth seems to date back at the very utmost not beyond two centuries, of which the present appears to have been the most productive as regards religious structures. Even now, although, according to Mr. Beglar, armed gangs of 50 and upwards roam about levying contributions or black-

mail on the villages within their beat and robbing travellers, the prosperity of the district is, on the whole, on the increase. These armed gangs are said to be not wholly destitute of chivalrous feeling, which has induced them on occasions to restore to their owners ornaments taken from unprotected women. It is, however, no uncommon thing for these lawless men to lop off hands and feet for the sake of readily obtaining ornaments, while their daring is such that, during Mr. Beglar's sojourn there, they robbed several fields of ripe tobacco within a stone's throw of the fort of Bhind, the headquarters of the local Subah.

Having visited the fort of Jaytpur, Irich, where there are several ancient remains, and other places of minor importance, Mr. Beglar obtained photographs of the magnificent temples of Khajuraha, which have already been described by General Cunningham, and which form by far the largest and finest group of temples in Northern India. Rajgarh, Ajaygarh, and Panna were next visited, the hills near the last place being noted for their diamond mines. Pathari (about 150 miles due south of Gwalior) possesses numerous and extensive remains, and the Gadarmal temple in the vicinity is remarkable for exhibiting four periods in its history, its construction dating probably from the eighth century at the latest. Mr. Beglar recommends strongly the adoption of some measures for the conservation and care of these most interesting ruins, the gate especially being in an unsafe condition. The next object of note described by Mr. Beglar is the great temple at Udaypur, dating from 1509 A.D., which is conspicuous for its numerous inscriptions, its general beauty, particularly in the execution of the floral sculptured ornament, and the legend connected with it. Eran, about six miles north of Pathari, contains a *varaha*, or Boar, which is interesting both for its size and beauty, and for being probably the oldest known Brahmanical image in India which boasts an inscription fixing the date indisputably.

Mr. Beglar's tour in 1873–74 began at Jabalpur and closed at Bharhut, the districts comprised within the tour being the eastern half of the Central Provinces to the east of the Great Jabalpur and Nagpur road, and of the Wain Ganga, with portions of Riwa. During this tour he visited many places now little known, but once large towns possessing rich temples. Some of these are still

standing, but the greater number are in ruins. From these he collected many ancient inscriptions ranging from 600 or 700 A.D. down to 1300 and 1400 A.D. Several of these are of considerable interest as they show the widely extended power of the Haihayas of Chedi. None of these inscriptions have yet been translated, but General Cunningham has made a very close examination of all the older ones, and is confident that they will throw much light on the history of this part of India, from the beginning of the Christian era down to the Muhammadan invasion. One of Mr. Beglar's discoveries was the rock cut seal of the powerful King Sasangka, who destroyed the holy Bodhi tree at Bodh Gaya shortly before A.D. 600. The seal is cut in the rock of the fort of Rohtâs (which must therefore have belonged to him) on the Son river. Mr. Beglar also made a very rich collection of photographs of the curious old temples in these little known places. Several of these are of considerable antiquity, and their inscriptions when translated will form a valuable addition to existing data for the history of Indian architecture.

Volume VIII. deals with the period intermediate between the two former trips, being a description of a tour made, in 1872–3, in the following districts of the Lower and North-west Provinces, viz. :— Patna, Gaya, Mongir, Bhagalpur, Santal Parganas, Manbhum, Singbhum and Birbhum, Bankura, Raniganj, Mirzapur, Jaunpur, Allahabad, Bardwan, and Hughli.

In Patna there are several points of comparative geography which require settling. Patna itself is probably the ancient Pataliputra, with which the Palibothra of Pliny must have been identical. The identity of the Son river with the Erranoboas, at whose junction with the Ganges, Palibothra was situated, is not so clear. Mr. Beglar shows that the Son river shifted its course considerably to the west about 750 A.D. This had an influence on the course of Ganges and caused it to shift southward, and so cut away a large portion of its south bank, and with it the site of Pataliputra. The Erranoboas (chiefly on account of its reputed size, which was said to be third to the Ganges and Indus) Mr. Beglar identifies with the Gandak (and not as most authorities have hitherto done with the Son), and the Condochates with the Chota Gandak. General Cunningham, however, differs from this view, and points

out that the Gandak was supposed to be a female river, while the Hiranyabaha or Erranaboas was a male river, like the Sona.

Besides following a portion of the Chinese pilgrim Hwen Thsang's route in the fertile and densely populated plains of Magadha, Mr. Beglar traces the old great lines of roads between the more important centres, and, having regard to the physical features of the intervening country, fixes by this means the secondary points and the sites or lines which promise to yield return. Of the places known to possess ancient remains, or to be otherwise of archæological interest, in the districts of Gaya and Patna, Mr. Beglar gives a list divided into groups.

In the last "Abstract of Surveys" a brief account was given of Mr. Burgess's archæological investigations in Western India during the season of 1874–5. It now remains to notice his subsequent operations.

Early in November 1876 he visited the caves of Mandapeswar and Magathana, in the island of Salsette, and then those of Kuda, in the Janjira Creek, of which he made plans, and took copies of the inscriptions, which have since been translated by Professor Jacobi, of Münster. He next visited Lonad, near Kalyan, and Kondane, near Karjat, at the foot of the Ghat, on the railway from Bombay to Poona, taking plans of these little known caves, the second of which turns out to be one of the oldest groups in Western India. The survey party then went to Junnar, taking additional drawings there, and thence to Dhokeswar, where is an old Brahmanical rock temple, hitherto unvisited, and from thence by Ahmadnagar and Aurangabad to Elura, where the remainder of the season was spent in making a pretty complete survey of the very extensive series of Bauddha, Brahmanical, and Jaina caves there. Among other drawings made are plans, elevation, and section of the great Kailas temple, and its extensive adjuncts, to a scale of 5 feet to 1 inch, besides plans of all the most important of the cave temples and sections of several, with a very large collection of detail drawings of columns, doors, sculptures, &c., which, if published *in extenso*, would form a most valuable illustration of Hindu art and mythology extending over a period of four centuries or more.

Mr. Burgess himself visited Ajanta to plan the work to be done there next season, and then made a flying visit to the caves of Bagh,

in Malwa, rejoining his camp on its way to Nasik caves, where a number of drawings of details were executed. Mr. Cousens, the first assistant, was then sent to Nanaghat to copy, if possible, the great inscription of Satakarni there, while Mr. Burgess and the rest of the staff began the work at Kanheri, near Thana, which, however, could not be more than fairly begun before the end of the working season.

Mr. Burgess returned to England in May 1877, and, in order to work up the materials accumulated, he did not go out again in autumn, but the survey was carried on, under his direction and in a most satisfactory way, by Mr. Henry Cousens, his first assistant. The Kuda caves were revisited and photographed, and a complete series of impressions made of their inscriptions; the caves at Mhar and Kol were also surveyed. He then photographed the Chaitya cave at Kondane, and made a very complete architectural survey of the important groups of Bauddha caves at Karle, Bhaja, and Bedsa, all in the Sahyadri Hills, between Bombay and Poona. He next surveyed the Jaina and Brahmanical caves of Ankai, and the little known but very early Bauddha caves of Pitalkhora in Khandesh, as well as the Brahmanical and Jaina caves in the same vicinity. The staff were then engaged at Ajanta for some time, and made an excellent series of drawings from the extensive series of caves there.

The party next went to Karhad, 30 miles south of Satara, where there are three numerous groups of caves, which were also fully surveyed before the end of the season, and the drawings sent to Mr. Burgess.

In the meantime Mr. Burgess extended his Third Report (for 1875–76) by numerous additions, and carried it through the press, and, with Mr. Fleet's assistance, projected and superintended the preparation and printing of a collection of 286 Pali, Sanskrit, and Old Canarese inscriptions, to which Mr. Fleet also prefixed a brief but important analysis.

He also commenced the preparation of his Report on the Rock-cut Temples, which is now in a forward state, and for which J. Fergusson, Esq., D.C.L., F.R.S., is writing the preliminary chapters. (See *infrà*, p. 45.)

Returning to India in October 1878, he commenced the survey at Sailarwadi, near Poona, where is a group of little known caves,

and thence visited and surveyed single caves and small groups in the country round, as at Deogarh, Walak, Nanoli, Bhamchandra, &c., and thence proceeded to Junnar, where photographs were taken, and then to Nanaghat to try to photograph the inscriptions there, and to Harischandragadh where the Brahmanical caves and old temple were surveyed. The staff next proceeded to Sinnar, in the Nasik district, where photographs, plans, and detail drawings were made of the very fine old temples there. Mr. Burgess, however, owing to an accident, was obliged to leave the work here to his assistant, and proceed to Nasik for surgical aid. The staff rejoined him at Pandu Lena at Christmas, and Bhagwanlal Indraji Pandit took excellent impressions of all the valuable series of inscriptions in the caves, and discovered many important corrections in the older readings of them. The Jaina caves at Chamar Lena were also examined.

Mr. Burgess next visited personally the Jaina and Brahmanical caves at Ankai, near Manmad, at Pitalkhora, near Patan, in Khandesh, and the celebrated monolithic Rathas and caves at Mamallapur, or the Seven Pagodas, near Madras, which also come within the scope of his next Report, while the camp went on to Bhamer and Balsane, in Khandesh, where Mr. Cousens surveyed the Jaina caves and old Brahmanical temples. Rejoining the staff at Ajanta, the survey of that very beautiful group was completed in a large series of detail drawings, and Mr. Burgess wrote a full account of each of the caves, and of the frescoes that are still left in them, which has been put in type by the Bombay Government, with a number of illustrations of the paintings, sculptures, and inscriptions. By the assistance of the Hon. J. Gibbs, C.S.I., a copper-plate grant of the Vakataka dynasty, who appear to have excavated some of the caves, was also recovered, and a transcript of it is given in Mr. Burgess's Notes by Pandit Bhagwanlal Indragi, who also recopied and took careful impressions of the inscriptions at Ajanta; he also contributes an Appendix containing some curious information about the mythology and practices of modern Buddhists in Nepal, where he spent some time, and from which he brought impressions of a series of very old and important inscriptions, of which his versions, with notes, will be edited for the "Indian Antiquary" by Dr. G. Bühler. Mr. J. Fergusson has recently read a paper on some of the Ajanta

frescoes copied by Mr. Griffiths, in which he tries to show that a scene on the walls of Cave I. represents an embassy from Khosru Parviz (Chosroes II.) to Pulikesi II., in the first half of the seventh century. Without knowing of this, it appears that Mr. Burgess and Bhagwanlal had independently come to the conclusion that the fresco in question did represent a Sassanian embassy, and had been painted early in the seventh century. Some of the oldest painting is found in Caves IX. and X., two Chaitya caves, and is believed by Mr. Burgess to be not later than the 2nd century, A.D.

Mr. Burgess and the Pandit left Ajanta early in March, and visited Indor, Ujjain, Dhar, and the caves of Bagh, which he surveyed roughly, and took notes of the fresco paintings, which are fast decaying, but which it seems are of curious interest and deserve to be copied before they entirely disappear. Full notes on these were also secured, as well as a reproduction of a Sanskrit inscription at Cintra in Portugal, copied by an English traveller, Murphy, in the latter part of the last century, of which archæologists must desiderate an impression or rubbing. The Pandit in a transcript has corrected some of the errata, but others are left untouched.

While Mr. Burgess was in Central India his first assistant accidentally discovered how the paintings in Caves XVI. and XVII., the most interesting in the Ajanta series, have of late years been so much injured by some unknown person or persons cutting out all the best heads and faces of figures. A fresh one having been cut out one day in March, Mr. Cousens noticed it, and had no difficulty in tracing the act to the Peshkar of Ajanta, who takes it upon him to act as guide to visitors passing through Ajanta. This has been reported to the Government of H. H. the Nizam, and it is hoped such Vandalism will be summarily put a stop to.

The Survey Party next went to Kanheri where the work had been left unfinished in 1877, and resumed it and the survey of other remains in the island of Salsette. Among the latter are six curious monumental stones at Borwali, with numerous figures, ships, &c., carved on them, which were photographed.

Mr. Fleet being at home on furlough, his services were secured for a short time to superintend the lithographing of fac-similes of a number of ancient copper-plate grants, which will be published by

and by, along with others, as an instalment of a collection of the Historical Inscriptions of the Dekhan or Peninsular India.

An important archæological work (referred to above, p. 42) is under preparation by Messrs. James Fergusson and James Burgess, conjointly, on the Rock-cut temples of Western India. This work will be the fruit of the survey instituted, at the desire of the Secretary of State for India, in 1873, and will be a popular description of the architectural antiquities of Western India, and especially of the rock-cut temples. Of these there are between 40 and 50 groups belonging to various sects, the great majority of them being in the Bombay Presidency and districts contiguous to it. Besides these there are a few insignificant groups in Sindh, the Panjab, Afghanistan, and Baluchistan, an important historical group at Buddha-gaya in Behar, and a few at various other places in Orissa, Malwa, and the Madras Presidency. These rock excavations, which occur chiefly in hill ranges, and were all for either worship or monastic purposes, are divided primarily into three classes according to the sects by or for whose use they were hewn out, viz., Buddhists, Brahmans, and Jains. The earliest examples extant belong to the Buddhists, and date from about the end of the 3rd century, B.C., but excavations belonging to the sect extend down to about the 7th century of our era. The next are those of the Brahmans, which range from about the 4th to the 8th century, or perhaps later; and lastly, the Jaina rock temples which are much less numerous than those of either of the preceding sects, and of which the earliest may belong to the 5th or 6th, and the latest perhaps to the 12th, century.

An archæological work of some interest has been lately issued from the Bengal Secretarial Press at Calcutta, entitled "Buddha "Gaya. The Hermitage of Sakya Muni." It is by that well-known Orientalist and Archæologist, Rajendralala Mitra, LL.D., C.I.E., &c., and contains a description of the locality* and the remains there extant, and an account of the penance of Buddha, which is supposed to have taken place at that spot. This matter takes up two chapters; the third, fourth, and fifth deals with the various architectural remains, the sculptures, and inscriptions, and a concluding chapter is devoted to a consideration of the chronology

* Buddha Gaya is a large village in Behar, lat. 24° 41′ 45″ N., long. 85° 2′ 4″ E.

of the temple. It is illustrated with upwards of 50 photographs and lithographs.

Another work of somewhat similar character was published in 1878, entitled "Gaur; its Ruins and Inscriptions." By the late J. H. RAVENSHAW, B.C.S. Edited with considerable additions and alterations by his widow. Gaur was one of the metropoles of Bengal in the time of the Hindu kings, and its remains (especially the later ones) are of great beauty, and have attracted the attention of successive archæologists. Its authentic history commences with its conquest, about 1200 A.D., by the Muhammadans, who retained it as the chief seat of their power in Bengal for more than three centuries, during which period numerous mosques and other Muhammadan buildings were erected. Mr. Ravenshaw's work contains detailed descriptions, with numerous excellent photographs of these and other remains in Gaur, Maldah, and Panduah, all of which places are in the Maldah district of the Lower Provinces. The last chapter of the work contains copies and translations of the principal inscriptions.

The Government of India have sanctioned the publication of a useful "List of the objects of antiquarian interest in the Lower Provinces of Bengal" (Calcutta, 1879). The chief value of this work lies in the fact that, besides making use of most of the published authorities on Bengal antiquities, the compiler has had access to the official archives, comprising letters from district officers, &c., which appear to have yielded a store of data. The district and locality, and a concise description of each object, is given.

No steps have as yet been taken for organising an archæological survey of the Madras Presidency, but during 1876 Mr. R. Sewell, of the Madras Civil Service, was engaged in making excavations and researches among the antiquities of Bezwada at the rock-cut temple of Undavilli, close to the Kistna river in the district of that name, and the Buddhist monument at Amravati. Owing to various circumstances Mr. Sewell's report on the first two of these operations has only recently been received, but it shows how much interesting work might be achieved in the Presidency by an archæologist, with moderate means and time at his command, for effecting a complete survey of the numerous monumental relics of the past scattered throughout its area.

The rock-cut temple at Undavilli on the south bank of the Kistna, originally a Buddhist *Vihara*, but subsequently converted into a Vaishnava shrine, has been for some time known to archæologists, but owing mainly to the fact of its being half hidden in in the *débris* of centuries, it has not up to the present received all the attention it deserves. About a mile from it, on the north bank of the river, is the town of Bezwada, the head of the network of canals forming the irrigation of the Kistna district, and the trade centre of those parts. Bezwada is surrounded by high hills of granitic formation, in which is a large number of Buddhist rock-cuttings, monastic cells, caves, and other like remains. In the town itself are several Brahmanical shrines of considerable antiquity, among the walls and pillars of which are occasionally to be seen slabs and sculptures, noticeable either for their great size or beauty or as evidently belonging to a period anterior to that of the present buildings. Stone inscriptions of various dates, from the 7th century downwards, abound.

The rock-cuttings on the hill to the west of Bezwada are many of them of large extent, and hereon platforms, temples, monasteries would appear, from the account given by Hwen Thsang, to have been erected. Of the remains now extant a detailed description in his report is given by Mr. Sewell, as well of the remains unearthed at Undavilli. He also contributes an historical sketch of the Bezwada and Undavilli remains, as well as a note on the Buddhist antiquities in the neighbourhood of the former, and a catalogue of the stone sculptures, &c., in the library at that place.

A second report is promised on Mr. Sewell's important investigations at Amravati, where, although he stayed for only a week, he was fortunate enough to disinter from the *stupa* 90 new marbles, some exceedingly beautiful and interesting, and in most remarkable preservation. When we remember that on the base of about 160 worn marbles, forming Sir Walter Elliot's collection in the India Museum, Mr. Fergusson laboriously built up the materials for his magnificent work on "Tree and Serpent Worship," the value of these well preserved sculptures will be more readily appreciated.

Meteorology of India, 1877.

The *Report on the Meteorology of India in* 1877 (the third annual report) is by Mr. John Eliot, M.A., Officiating Meteorological Reporter to the Government of India, and, though dealing with the same area as the preceding reports, it exhibits progress, in that the various districts are better represented; several new stations having been started in Western India and British Burma. Owing to the interest displayed during the past two years of drought in the question of Indian rainfall, additional tables have been prepared giving the monthly and annual average rainfall, and to secure this end great efforts have been made to bring together the rainfall records of past years, especially from Madras and British Burma, for which two important districts of the Indian monsoon region average rainfall tables are given for the first time. Mr. Eliot's deductions show that the meteorology of the year 1877 presents a combination of features of unusual interest, it having been a year of abnormal irregularity in every element of meteorological observation. For the first time since the institution of systematic observations there was for a lengthened period persistent high pressure over the whole of the Indian area. During the latter part of the hot season and the rainy season of the year, a belt or ridge of abnormally high pressure was formed across the north of the peninsula, beyond which, in the Punjab, Rajputana, and North-west Provinces, the rains of the south-west monsoon almost entirely failed. Happily this was followed by copious precipitations in October, and the threatened famine was thus averted. In Northern India during the greater part of the rains the Bay of Bengal monsoon current was steadily diverted eastward. In Southern India, which in 1876 and the early months of 1877 was visited by a widespread and prolonged drought and famine, general and copious rain commenced in September and continued during the cold weather, thus terminating one of the most fatal and disastrous, natural calamities of recent years in India. These irregularities, which Mr. Eliot describes as large and massive, receive very careful analysis and discussion in his report, and he suggests, with much apparent truth, that a partial explanation of their occurrence will be found in their compensating character, *i.e.*, that excess in one region is balanced by defect in another. Mr. Eliot too argues in favour of Mr. Blanford's views respecting the cyclical variation of

the sun spots, and of rainfall, that the magnitude of the former is very small compared with the extent of surface free from spots, and that, in the case of the latter, the most careful researches show that the total cyclical variation does not exceed 15 per cent. on the whole. The report discusses the meteorology of the year under the following heads :—Temperature of solar and of nocturnal radiation, air temperature, atmospheric pressure, anemometry, hygrometry, cloud proportion, and rainfall. The author also supplies a final general summary, discussing the interpendence of the characteristic features of the several meteorological elements during the year. In the appendices are very copious tables exhibiting the reduced and corrected registers, and there are also charts illustrating the average distribution of temperature and pressure, and the mean wind direction in each month. The whole work forms a goodly sized quarto of 375 pages; it will prove a valuable addition to meteorological science.

In recording his general conclusions respecting the meteorology of India during 1877, Mr. Eliot dwells on the necessity of tracing the laws of the major irregularities, a task which ought to be much facilitated by the almost complete isolation of Southern Asia and the Indian Ocean as a meteorological area, and by the extreme simplicity and persistency not only of its ordinary climatic features, but of all the major irregularities. "Thus" (Mr. Eliot remarks) the north-east monsoon prevails in its full integrity over the whole of India from November to the middle or end of February. Local sea winds gradually set in round the coast and increase in intensity and extend their area of influence during March, April, and May. During the latter half of May and the beginning of June, the sea winds are still further intensified and converted from a shallow atmospheric current to a deep current of remarkable steadiness and force. This blows towards the peninsula of Southern India as its goal during July and August, and begins to weaken in September. During that month and the month of October, it gradually retreats and thins off, yielding place to the north-east trade winds. Each of these lower atmospheric currents is remarkably persistent during the period of its prevalence, and each retreats very slowly and gives way very gradually to the other. Other instances might be given

of the marvellous regularity attending the normal meteorological changes in India; but what is known to be true of the regularities which form the climate, recent investigation shows to be equally true of the irregularities, which constitute the weather or current meteorology of India." It is a most important fact or principle, which the study of the meteorology during the past three years has given, that any peculiar or abnormal atmospheric condition has a tendency to perpetuate itself for prolonged periods, varying from months to two or three years. This is true on the whole, because it is true for every element of atmospheric observation. The study of these persistent abnormal atmospheric states will form a prominent feature in the future study of the meteorology of India, because as soon as they have been reduced to law and order, weather prevision in regard to the contingency of famines will become a possibility.

The most striking fact in the meteorology of the year 1877 was the existence of certain prolonged great irregularities of atmospheric condition. This persistency was manifested by unusually cold and rainy weather during the first five months of the year in Upper and Central India, and by the continuance at the same time of drought and famine in Madras and the Deccan. The air motion over the whole of Northern India was during this period much feebler than usual, while the Central Provinces on the other hand formed an area of increased atmospheric motion. The directions of the lower air-currents presented well marked persistent deviations, among which may be mentioned the excessive rainfall over the coasts of Travancore, Malabar, and Canara, and the diminished rainfall over the west Indian coast region to the north of Goa. Similarly the two great branches of the monsoon current were diverted. The Bay of Bengal branch was steadily and largely diverted into Burma, an abnormality which was followed by excessive rainfall over that region by westerly winds and a ridge of high pressure from Saugor through Calcutta to Goalpara, while the Arabian sea branch of the monsoon current was diverted in the same direction and gave copious rain to the Central Provinces, to the southern half of the west coast of India, and to the Deccan and Southern India. Similarly in these parts there was an abnormally strong westerly element in the wind directions, and the formation of a barrier of

high pressure from the coasts of Guzerat and Sind across Central Rajputana to Bundlecand.

The establishment of the north-east monsoon in November and December 1877 was accompanied by the development of the same features which had characterised the early months of the year. There were abnormally heavy cold weather rains; in Upper India the air motion was steadily below the average, while in the Central Provinces it was above it; in the Himalayan region there was the same feature of excessive snowfall. Many other instances might be cited of the persistency of abnormal atmospheric conditions in India, and of which the year 1877 has been a striking illustration.

The second principle which the meteorology of the year 1877 establishes is, that these abnormal variations are almost, if not entirely, compensatory in character. Thus the high pressure in India and Australia in 1877 was probably compensated by low pressure in China. The persistent low temperature of the cold weather months in Upper India were compensated for by excessive rainfall in Burma, and other important instances are cited by Mr. Eliot of this compensatory character of the atmospheric variations.

Mr. Eliot considers that the following inferences are suggested by the meteorology of India during the years 1877 and 1878. There is a tendency at the minimum sun spot periods to prolonged excessive pressure over India, to an unusual development of the winter rains, and to the occurrence of abnormally heavy snowfall over the Himalayan region, especially in the west. This appears also to be usually accompanied by a weak south-west monsoon, the usual characteristics of which are great irregularity in the distribution of the rainfall over the whole of India, and the occurrence of local rainfalls, recurring over limited areas, as well as the persistent and prolonged absence of rain over considerable areas, such as the dry region of the Deccan or Upper India, where the rains are more likely to fall below the amount necessary for cultivation than over the Malabar coast or in the Lower Provinces. But though geographical position sufficiently explains the tendency to the recurrence of famines in certain areas, the primary cause must be sought for in the great atmospheric current which is the source of the rains.

The experience of recent years shows that the tendency at minimum sun spot periods to the occurrence of excessive winter rains and snowfall in Northern India influences the meteorology of the whole of Northern India, giving rise to increased pressure, diminished temperature, &c. during the period immediately antecedent to the rains. The baric gradient of the south-west monsoon being smaller than usual at its commencement, the monsoon is weak and feeble, a larger amount of the aqueous vapour being probably deposited over the sea area before it reaches India. In India the rainfall is more irregularly distributed than usual, local heavy rains over limited areas being accompanied by drought, either partial or complete, over other areas. The probability of such drought depends partly upon the geographical position of the area, but mainly upon the antecedent abnormal atmospheric conditions, in so far as they modify the direction and strength of the lower atmospheric vapour bearing currents.

Another report by the same gentleman treats of the Madras cyclone of May 1877, which struck the Coromandel coast on the evening of the 18th idem, advanced along the edge of the Chota Nagpore plateau, and finally disappeared in Bengal after a prolonged existence on land of upwards of 80 hours. Mr. Eliot has subjected all available land meteorological observations, as well as those recorded in the loss of several vessels, to a very searching discussion, and the result of these researches is to him conclusive in favour of the "condensation theory" of the origin of cyclones in the Bay of Bengal, and thus affords a very strong confirmation of the validity of the reasoning employed in the Backergunj, or 1876, Cyclone Report, which was of peculiar importance as tending to upset the notion of cyclones being formed by parallel winds blowing in opposite directions, as contended by Dr. Meldrum, the late Mr. Willson, and others. Mr. Eliot's present paper contains also a detailed and able refutation of Dr. Hann's criticisms on the Backergunj cyclone work. The subject of the true predisposing causes leading to the formation of the terrific cyclones of the Indian seas is of one of surpassing interest, and Mr. Eliot's present work is a contribution of importance to general as well as scientific literature.

Mr. Blanford has recently prepared a useful table showing the average monthly rainfall for past years for 22 different regions in India, as compared with that of the past year (1878). The regions are not coterminous with any administrative boundaries, but are simply tracts, each of which is tolerably uniform in rainfall characteristics. This classification or subdivision of India into physical tracts was adopted by Mr. Blanford in discussing the rainfall question for the information of the Famine Commission.

The table is most graphically illustrated by two maps; one showing the entire Indian empire subdivided into the regions referred to, which are distinguished from each other by different colours, and the second showing only three shades to represent differences of rainfall, but giving as well the mean annual rainfall in conspicuous figures for all the principal stations. This table will be very probably presented to Parliament, as it gives a very clear notion of the distribution of rainfall throughout India, and of the extent to which any particular tract may have been impoverished by its deficiency during the past year.

Mr. F. Chambers has published a "Brief Sketch of the Meteorology of the Bombay Presidency in 1877," in which he points out that the meteorology of the year, like that of 1876, was particularly marked by the unseasonable distribution of the rainfall. In the early months of the summer monsoon season much anxiety was felt lest a prolongation of the famine, induced by the deficient water supply of the previous year, should ensue, but happily these serious anticipations were not realised to any great extent. From a scientific as well as from a practical point of view these unusual variations of the weather are of special interest, and the abnormalities of the various meteorological phenomenon, as well as their physical relation, are carefully discussed by Mr. Chambers in the present pamphlet. A set of tables and diagrams at the conclusion show the recorded results for each month, and the "abnormals" in a graphic form.

Statistical Survey and Imperial Gazetteer of India.

The Statistical Survey of India progresses steadily, though the disastrous famines of recent years have done much to retard it. It represents a series of local inquiries and comparative statistics spread over an area but little less than that of all Europe, excepting Russia, and dealing with a population exceeding that of all Europe, less Russia. No other Government in the history of the world has undertaken a statistical enterprise of so vast a magnitude. It forms, moreover, the only instance of a great statistical account of a country being carried out from the initial stage of the systematic local investigations, district by district, to the final alphabetical arrangement of the results in a gazetteer. The systematic Statistical Survey, district by district, will make about 100 printed volumes; their alphabetical arrangement forms the eight volumes of the Imperial Gazetteer.

At the close of June 1878, the number of volumes of the Statistical Survey published amounted to 78. The past 12 months have seen the issue of six more, viz., two volumes for Madras (Godavari and South Arcot), two volumes for Assam, one for Coorg, and one for Aden. The completion of the Bombay Statistical Accounts is confidently looked for in 1881, but that of the North-west Provinces and Madras district is still distant, operations in the last-named Presidency having been seriously interrupted by the events of the past two years.

This state of affairs will not, however, cause any delay in the preparation of the Imperial Gazetteer of India, which is actively progressing under Mr. Hunter's superintendence at Edinburgh. All articles up to H. inclusive have been passed for press by the Committee of the Council of India, on whom the task of revision is imposed, and the Gazetteer itself will be actually finished in February 1881.

Indian Trans-frontier Explorations, 1877–78.

The years 1877 and 1878 have been marked by special activity in the work of exploration beyond the British frontier of India. The principal cause is, of course, the impulse given by the war in Afghanistan, which has brought into prominent light the necessity of possessing a more exact knowledge of the topography, and the political, commercial, and military circumstances of the countries immediately adjoining our own frontier territories. The Surveyor-General of India, appreciating fully the importance of the desideratum, took prompt steps to attach to each of these expeditionary columns an adequate surveying staff, whose work, when elaborated and published, will enable a vastly superior map of Afghanistan to be constructed, and will add materially to our general knowledge of the country.

Although full reports on the doings of these officers have not as yet reached this country, the present appears a convenient time for glancing at such accounts as we possess of the various explorations which have taken place immediately beyond the British Indian frontier line during the years 1877–78.

Foremost among these may be mentioned the survey of a new route between India on the one side and Quetta and the Pishin valley on the other. This is known by the name of the Thal-Chotiali route, and it debouches into British territory by several passes through the outer Sulimani range, between 29° and 31° N. latitude, the more direct of which passes converge on Dehra Ghazi Khan. This town would form a very convenient base of communication between India and Candahar, as it is but 43 miles distant from Multan, on the line of the Indus Valley railway; it is comparatively close to the hills; there is no dangerous desert to be crossed between it and the nearest passes of the Sulimani range, and it is well situated for the concentration of troops coming either from the north or south.

The village of Kushdil Khan, at the eastern end of the Pishin valley, where there is a substantial mud-built fort, was selected as the depôt for the supply of the expedition, and became the starting point of three columns composing it. The first, which formed Major Sandeman's escort, preceded the second under General Biddulph, by a few days, the third under General Nuttall following

the next day. A gentle rise over the Suranari Pass led into the valley of the Surkhab, which in its physical aspects is but a repetition on a small scale of the Pishin. At the north end of the valley rises the giant peak of Kund, the central point of the great upheaval which separates the drainage of the Indus from that great basin which absorbs the Argandab, Kadanai, and the Lora. From Kund and the extension of the water-parting southwards, there flow eastwards two great rivers, the Zhob and Bori, which in their even course through open valleys, and wide well-cultivated plains, afford the finest openings for a route to India. The Zhob valley, however, does not lead direct to Dehra Ghazi Khan, but trends away northwards in the direction of the Gomul. From Bolozai, in the Surkhab valley, the road as far as the Ushtari pass, a broad and most convenient pass over the water-parting, is good and offers every facility to the road maker or railway engineer. Long before reaching the Ushtara pass a remarkable sudden transformation of scenery occurred; the shale or clay hills are replaced by an out-crop of red sandstone, producing marvels of picturesque outline. The Candahar side of Afghanistan is most uninteresting, but eastwards the scenery resembles that of Switzerland. Before reaching Chimigan again the *entourage* underwent another change, and the road lay through rich, open, well-cultivated plains, well-watered with abundant irrigation, full of villages, and green with young wheat; the clustering fruit-trees and walled gardens about the scattered houses recalling vividly many a similar scene in the plains of Lombardy. Round about the route on either side lay scattered hills of wild and rugged aspect.

The first column, forming Major Sandeman's escort, followed the Bhori route about as far as Kaha and then turned southwards *viâ* Smalan and Baghao, with the intention of following the route *viâ* Thal and Chotiali. At Baghao the Chief of Zhob collected some 3,000 men, and mistaking the first column for the remnant of our army that had been beaten at Candahar, and was in full retreat to India, made a very inefficient attempt to arrest its further progress, losing 300 men, and being taught a lesson which he will doubtless remember.

As far as Anumbar, where the Bori river takes a sudden turn to the south-west, there is an open road requiring no engineering

skill whatever to make it available for the passage of an army from Pishin to Dehra Ghazi Khan. From Anumbar to the valley of Rakni under the Sulimani range or to Vitakari, the site of the proposed new cantonment, there is still a continuation of this open road; but its directness is lost across a band of knife-ridged hills running in broken but parallel ranges with a south-westerly trend. The second column, under General Biddulph, held to the straightest route, and passed into the Chamalang valley, twisting considerably among the narrow precipitous ranges enclosing the Hannokoi pass to Baladaka, and so through the Han pass to Hasni Kot and the valley of Lugari Barkan.

Through the whole length of these passes there was not a mile of road that really required "making," nor a mile along which, in the opinion of Captain Holdich, a line of railway might not easily be carried; but the most direct route to Dehra Ghazi Khan is probably one rather to the north of the Han pass route called the Karwaddi, which offers almost equal facilities.

The first column which marched *viâ* Thull and Chotiali passed by a circuitous route, reaching the Lugari Barkhan valley a day or two later than the second column. Efforts were made to find a more direct route between Thull and Vitakari, but the routes explored are all equally good (or bad) and equally long. The chief reason for the occupation of Vitakari is that it dominates the country of the Maris who hold the Bolan, while it is also conveniently situated at the head of the Chachar pass, a pass of exceptionally easy character and gentle gradient.

The Vitakari plain has accordingly been occupied for some months past by a detachment of British troops, the territory being the property of the chief of the Lugari tribe, who is a British subject, and has offered it to our Government for the purposes of a cantonment; for this it is well suited, in contrast to the burning plains of the Indus, as it is about 4,000 feet above sea level, and possessed of fertile soil and an unfailing supply of water even in the hottest season.

The most direct route is, as said, that of the Bhori valley and the Karwaddi pass, and thence *viâ* the Sun, Sakki Sarwar, or Fort Munro pass into the plains of India. Fort Munro is already an established station on the Sulimani range, with a good road to the plains, its elevation is considerable (6,500 feet above sea level), and

the road is consequently too steep for military purposes, but the Sakki Sarwar pass only a few miles north of it is much lower, and might doubtless soon be converted into a fair military road.

As far as we know, the Bhori Karwaddi route is the most direct of all the routes to Candahar, but there is certainly a number of alternative routes that could readily be used for military purposes. The Zhob route, too, debouching on the Gomul pass should not be lost sight of; it leads over a pass at Metrazai under the Kund mountain, about 1,500 feet lower than the Monandgai, the highest pass of the Bhori route, and is probably open and free from difficulty from end to end.*

Of the surveys executed in connexion with the Kurrum and Khaibar columns, by Captain Woodthorpe and Major Tanner, and assistants, respectively, no details have as yet reached this country, though it is known that they have been most actively and energetically employed. Captain Woodthorpe has been honourably mentioned in despatches for his gallantry on the occasion of the taking of the Peiwar Kotal, and Mr. Scott, a surveyor employed under Major Tanner, distinguished himself by an act of exceptional daring in endeavouring to save the life of a wounded native from the attack of a body of Afridis. Copies of Major Tanner's rough survey from Jamrud to Jelalabad have reached England, besides a mass of notes, topographical sketches, and other geographical material contributed by various officers attached to the Khaibar column. Major Tanner has since made an enterprising and partially successful attempt to explore the unknown country of Kafiristan on the slopes of the Hindu Kush. There can be no doubt that a complete reconnaissance of this country would enlarge most materially our knowledge of that great range and of North-eastern Afghanistan in general.

During the military operation in the Jowaki country in the cold season of 1877–78, two surveyors, Mr. A. J. Gibson and Mr. G. B. Scott, were deputed to accompany Generals Keyes and Ross, respectively, and Captain Beavan subsequently joined the party. The country referred to consists of a tongue or promontory of

* Most of the above particulars are taken from an able paper by Captain T. Holdich who accompanied General Biddulph's force. The topographical details have been inserted with praiseworthy promptitude on General Walker's map of Turkestan (4th edn.).

independent mountainous region projecting into British territory between Peshawar and Kohat, and with the exception of about 50 square miles of the hills in the extreme east, occupied by the Hassan Khels, the whole has been surveyed on the 4-inch scale. It was unsafe to venture to any distance from camp, and signals and marks of any kind being immediately thrown down and destroyed made surveying a hazardous and difficult matter. Notwithstanding these drawbacks 153 square miles were surveyed by Mr. Scott, and 100 square miles by Mr. Gibson on the 4-inch scale. A rough, but fairly accurate, survey of the Kohat pass was made by Captain Beavan and Mr. Scott.

Some valuable and copious notes on Eastern Afghanistan have lately been prepared by Major H. G. Raverty, (of the 3rd Regiment Bombay N.L.I.,) at the request of the Secretary of State. They are derived from Persian, Pushto and other oriental sources, and throw considerable light on the tribes, the passes, and geography of the regions referred to. The first section deals with the Baluch tribes of the Derahjat, viz., the Marlani, Nutkani, Kulachi, Hut, and others. We then find a description of the various passes (*darahs*) and routes leading from Multan to Kandahar by the Lower Derahjat. These are much more numerous than usually supposed, and consist of the following:—

Kaurah.
Wahwa.
Haja.
Litarah.
Barkue.
Liriah.
Bhati.
Khanwah.
Sanghar.
Drug.
Lundi.
Mahuey.
Widor.
Dalanah.
Sakhi Sarwar.
Kurah.
Kalah Khasurah.
Suwagri.
Ghati.
Kaha (Kuho or Harand).
Khalgari.
Mirlar.
Chachar.
Fajru.
Baghari.
Jahazgi (Cheghdee).
Thok.
Chak.
Shori.
Mughal.
Tahani.
Zangi.
Sat.
Jihari.
Suri.

The next part is devoted to an account of the expedition of Muhammad-i-Dara-Shukoh, son of the Emperor Shah-i-Jahan, against Kandahar in A.D. 1653, translated from the account given by Rashid Khan, who was present in Dara-Shukoh's camp. The prince advanced at the head of an army of 104,000 by way of the Sanghar pass and the Tal-Chotiali route. Besides containing a variety of valuable geographical information, the foregoing section concludes with a list of some of the principal places in Sind and Baluchistan accurately transliterated.

The second section describes in very full detail the road from Lahor to Kabul by the Khaibar pass, and some of the more important but less known historical events with which various points of that route are associated. Then follows an account of the various roads and highways of the province which branch off from Kabul, consisting of 25 routes. The first described is from Kabul to Baghzan, the chief place in Iriab, a road which leads also to Kurmah (Kurrum) and Bannu. This route corresponds to that usually known to English geographers by the name of the Paiwar and Shutargardan route, but no such pass as the latter is mentioned in Major Raverty's paper, and he inclines to think the name is probably quite modern. Next comes an account of the route from Kabul to Ghazni, by way of Logar, which route goes on to Kandahar and Hirat. We then have notes on Bangash and Khost, and these are followed by an account of the route from Kabul to Segi by way of Iriab and Kurmah, consisting of four different roads. The fourth route described is that from Kabul to Bazar-i-Ahmad Khan by Kurmah, and includes notes on Kurmah, Iriab, Paiwar, Shanuzan or Shaluzan, Zeran, and Karman. The fifth route is from Ghazni to the Bazar of Ahmad Khan by way of Dawar, of which country a description is given; the sixth, from Kabul to the Bazar of Ahmad Khan by way of Khost and Dawar, consisting of four different roads; the seventh, from Kabul to Kohat by way of Kurmah, and thence into the Derahjat; the eighth, from Kabul to Kohat by way of the Kohistan, or highlands of Tirah, a very difficult route, followed by notes on the Afridi, the Wurakzi, or Urakzi, and Shinwari; the ninth, from Kabul to Jalalabad by way of the Ab-i-Zindagani (water of existence, or river of life); and the tenth, from Kabul to Jalalabad by way of the Darah of Kajhah, or Kajha. This route concludes the present section, which will be followed by a section descriptive

of the routes north of the Khaibar road to Kabul, including the Karapah and Tahtarah routes, and various others both from Kabul and Peshawar, extending from Kafiristan to Ladakh. A subsequent section will bring the series of notes to a close by a description of the routes remaining to be described, leading from the Bazar-i-Ahmad Khan into the Derahjat, and from thence west toward Ghazni through the range of Mihtar Suliman, or Koh-i-Siyah.

"A subsequent section will contain a description of the routes remaining to be described, leading from the Bazar of Ahmad Khan into the Derahjat, and from thence west towards Ghazni through the range of Mihtar Suliman, or Koh-i-Siyah, and the series will close with some geographical and historical details respecting Western Afghanistan and routes to Balkh, Marw (Merv), and other places in that direction.

In Chitral and Yassin, beyond the north-west frontier of Kashmir, some very imperfectly known tracts were traversed by Major J. Biddulph in the course of an interesting tour in the autumn of 1878. The few geographical details noticed by him will increase our knowledge of these parts, at present based mainly on the accounts of the late Mr. Hayward and the "Mullah."

Speaking of the road up the Gilgit river, he remarks that for about nine miles on both sides of the Yassin frontier, the road is exceedingly difficult, with constant small but steep ascents and descents along the river bank, and with two rock staircases, extremely difficult to pass, about four miles apart. The valley is very narrow as far as Roshan, where it opens out a little, the hills on both sides rising to a great height in fantastic pinnacles and castle-like crags, with perpendicular scarps. The following day Major Biddulph marched from Yassin up the Woorshigoom valley towards Darkot. This valley, which above its junction with the Kho valley is narrow and stony, opens out considerably at Yassin, the mountains on either side lose their precipitous appearance, and travelling becomes pleasant and easy as far as Hoondur, where the valley again narrows, but the road to the Darkot pass is easy. The villages are small, and there is an evident want of population, much land lying uncultivated. Yassin itself has now a very small fixed population, and the country generally shows that it has never recovered from the oppressive rule of Gohr Aman and the losses suffered in the Dogra invasion of 1863.

In the Woorshigoom and Kho valleys are a number of stone circles, which are said to be of great antiquity. They are about 30 feet in diameter, formed of huge boulders, arranged with the flattest side outwards, placed so as to form a perfect circle about 3 feet high. On these are placed a number of flattish boulders of nearly equal size, projecting over the edge of the circle all round. The centre is filled with small stones and rubbish. The labour of transporting and placing such huge blocks in position must have been immense. The local tradition is that the circles are the work of giants in old days. They are, perhaps, relics of fire-worship. The most perfect is one on the tongue of land at the junction of the two rivers.

Major Biddulph marched by the Kho valley and reached Chashi (8,500 feet) on the fourth day. The road so far is exceedingly difficult; the valley is narrow and sparsely populated. Beyond Chashi the road leaves the main valley and rises suddenly among low rounded hills on to open Pamir-like ground for the next 34 miles till Laspoor (9,400 feet) is reached. Two miles beyond Chashi the Pandar lake, $2\frac{1}{2}$ miles long and $\frac{1}{2}$ mile broad, is passed at an elevation of 9,400 feet. This is said to have been formed by a landslip about 70 years ago, and is now gradually drying up again.

Eleven miles beyond Chashi, Ghizr or Shevare as it is sometimes called, is passed, whence a good road branches off into the head of the Swat valley. At 24 miles from Chashi the road leaves the Ghizr valley, and ascends gradually to the Shandur plateau, which is about 5 miles across and perfectly level. The height of the plateau is 12,000 feet. There are two pieces of water on it, the largest of which is $2\frac{1}{2}$ miles long and $\frac{3}{4}$ mile broad. There is no surface drainage from either piece of water, nor do they communicate with one another. Leaving the plateau, the road descends rather abruptly into the narrow Laspoor valley, and becomes again more difficult as far as Mastooch. The Laspoor district, though limited, is well populated, considering its small area, and is celebrated for its fertility. Mastooch (7,500 feet) is now a very small place, but is capable of supporting a considerable population, much land lying uncultivated. The Yarkhoon valley is here nearly a mile broad. Looking down the valley a magnificent mountain called Tirich Mir fills the whole view. Looking up the valley from Chitral in

the same way it occupies the whole landscape, and is said to be equally conspicuous from Zebak in the Oxus valley; it is said to be visible also from a great part of Kafiristan, where it is called Meysurnoon; it is the theme of many wonderful traditions, and roughly speaking, cannot be less than 27,000 feet high. Major Biddulph secured data for fixing its position and altitude. Below Mastooch the Yarkhoon valley has an average breadth of from three-quarters of a mile to a mile down to its junction with the Moolkho valley. The Tarbek plain, six miles below Mastooch on the right bank, is divided in half by a deep chasm, extending from the river to the hill sides. This can only be crossed at one place which is commanded by a stone tower, and is regarded as one of the chief defensible positions in the valley. When Mahmood Shah tried to invade Chitral from the north in 1872, an Afghan force from Dir occupied this point in support of the Chitral and Yassin forces that defended the pass itself. The fact is interesting as it shows the readiness of the people of Dir to make common cause with Chitral against an invader. Crossing the Yarkhoon and Moolkho rivers Major Biddulph entered the Chitral territory at Drasun on 1st November, where he was met by Aman-ul-Mulk's son, Afzul-ul-Mulk, a boy of about 13 years of age. Drasun (6,700 feet) is situated in the Moolkho valley, about 11 miles above its junction with the Yarkhoon valley. The Moolkho, Toorikho, and Tirich valleys, which constitute the most important part of Chitral Bala, are unmarked in any maps. The Toorikho valley runs nearly parallel with the Yarkhoon valley to its junction with the Tirich valley, below which it is known as the Moolkho valley; for nearly 20 miles above the junction of the Moolkho and Yarkhoon valleys, the two streams are separated by the Kargah Lusht plain, some 600 feet above the water levels, and the watershed forms the boundary between Chitral and Yassin territory. The Toorikho, Tirich, and Moolkhoo valleys are thickly populated, the cultivation being continuous. The villages extend high up the hill sides, supported by innumerable springs which gush out everywhere. The soil is mostly gravel and clay, the hill sides are bare and rounded, and wood is somewhat scarce. The Moolkho valley is very open, and the high peaks on both sides are invisible, being shut out from view by low hills that intervene.

The summer route from the Baroghil to Chitral, after crossing

the Shajanalli spur, lies down these valleys to the junction of the Moolkho and Yarkhoon stream below Drasun, where the former stream is the most considerable of the two. Below the junction of the Moolkho and Yarkhoon streams, the valley again narrows, and travelling becomes more difficult till within four miles of Chitral. The villages are large and populous, the land rich and fertile where cultivable, and the cultivation neater and better than in the Gilgit valley. The level of the stream in summer and winter varies about 20 feet. Below Barenis, a large village 20 miles from Chitral, Yassin territory on the left bank ceases. Four miles above Chitral, at the junction of the Injigan valley, the main valley suddenly widens, and its whole character changes. The hills no longer rocky and bare slope away gradually into grassy rounded tops with forest clad sides; looking south the valley retains this character as far as can be seen, the peaks on both sides are hidden from sight, and travelling becomes easy and pleasant.

Major Biddulph found it impossible to make any approximate calculation of the population ruled over by Aman-ul-Mulk, but should reckon it in ordinary times to be not less than 150,000 souls, without counting the tribe of Siah Posh Kafirs, who are tributary. The valley below Chitral is said to be thickly populated, and the land is noted for its fertility. Aman-ul-Mulk in conversation mentioned that he could dispose of 6,000 fighting men, but there is reason to believe that the number available is much greater. The people of Chitral are a handsome race, with dark gipsy looking features. They are noted for thievish propensities, but differ greatly in character from the Afghans. On one occasion a number of things were stolen from my camp, and no attempts to recover them were made by the officials until Major Biddulph remonstrated; the things were recovered the same day. Orpiment or yellow arsenic is found in great quantities in the Tirich valley and exported to Peshawur. Coffee is found in small quantities near Chitral, and iron is found lower down the valley near Narisal. Carpets of an inferior kind are made, and Chitral daggers and sword hilts are in much request in the neighbouring valleys.

The major states that he found by hypsometrical observations that the elevation of Chitral is considerably less than what has been laid down in the survey maps, being little over 5,000 feet. The

"Havildar" (Hyder Shah) who recently died at Jelalabad, and who is so well known for his trans-frontier explorations, made it 7,140 feet.

During 1877–78 Mr. E. C. Ryall was carrying on survey operations beyond the British frontier, in Hundes (the local name applied to the western part of Tibet), and adjoining tracts.*

This officer had been engaged in triangulating, in connexion with the Kumaon and Garhwal Survey, for some few seasons past, and this work has led him in several instances to extend his operations across the frontier into Tibetan territory, with which the British possessions are here conterminous. In 1877 the Surveyor-General directed Mr. Ryall to continue the Milam Valley series up to the frontier of Hundes, or Nari Khorsam (the name applied to that portion of the Upper Sutlej or Karnali basins which is under the Government of Tibet), and from thence to lay down some of the distant peaks in Tibet. This Mr. Ryall successfully accomplished, and the number of triangles measured by him were 38 in number, exceeding 100 miles in length.

At first the mountains encountered were of an average height of 9,700 feet, well wooded, and not over rugged, their slopes being studded with numerous villages and extensive patches of cultivation. On Mr. Ryall's arrival at the loftier stations, the inclemency of the weather and the very great depth of fresh snow, covering the mountains down to their very bases, were such that he anticipated his further progress would escape the knowledge of the Tibetan officials, owing to the deserted state of the passes at that early season. After five days' cutting through the snow, Mr. Ryall succeeded in crossing over into Hundes on the 8th June. By that time his arrival became known to the Tibetan officials, but by informing them that his object was simply to survey the northern limits of British territory, which he found it impossible to do from the southern faces, he succeeded in satisfying them and in obtaining permission to remain. With great despatch (for the rainy season was fast approaching) he fixed the most prominent points, which included the snowy peaks across the Sutlej, and at the head of the Manasarowar lakes and others lying at the head of the Darma and

* Mr. Ryall's Report on his Trans-Himalayan explorations during 1877 (with that of Mr. Kinney) forms the Appendix of the Indian Survey Report for 1877–78.

Byans valley, as well as the well-determined peaks in Kumaon and Garhwal, as a check on the new work. The remarkable peak Porgyúl (of which a striking description is given by Mr. Andrew Wilson in his "Abode of Snow"), was fixed, and differed in position but very slightly from previous measurements. From the Hundes station 38 peaks were laid down across the Sutlej. The most remarkable of these is Gurla, the Indian name for which is Mandhata, the legends of the Milam Bhotias being to the effect that the great mountain is the transformation of the body of a raja of Benares called Mandhata, who is said to have died some thousands of years ago on the shores of the Manasarowar lake, while on a holy pilgrimage to its waters. Gurla attains an elevation of 25,360 feet, while between it and Kailas (another well-known peak) lie the celebrated lakes of Manasarowar, (in Tibetan Tso Mapang), and Rákas Tál, (in Tibetan Tso Lagan). Kailas, though inferior in height to the former peak, is very striking in its appearance. It is not unlike a roughly made Hindu temple, with a few feet of its conical top broken off. This has led to its being invested by the Hindus of Northern India with a sacred character, which is enhanced by its prominent appearance and height, towering as it does full 2,000 feet above its compeers for 40 miles round. It is among the most conspicuous and impressive sights in the whole Himalayas. Mr. Ryall states that his triangulation of Hundes has been so far extended as to supply good bases for a detail survey, if it ever be desirable to have one.

Hundes or Nari-Khorsam is divided into three districts, viz., Tsaprang, Daba, and Purang, all under the governorship of the Garpan of Gartok, whose authority extends also over the district of Rudok, which, together with that of Gartok, comprise the country called Monyul. Mr. Ryall states that, as a rule, for about six miles after leaving the watershed line on the frontier, one finds oneself hemmed in by steep though not rugged spurs, which suddenly merge into almost absolute plains, sloping gently to within a few miles of the Sutlej, where they are broken up into narrow spurs or ribs separated by deep ravines. The cliffs thus formed in the alluvial deposits of which the plain consists, exceed 2,000 feet in height a few miles below Dongpu. The mountains that rise on the north of the Sutlej are rounded and undulating, with groups of small

peaks cropping up here and there. The average height of this range of mountains (which has no general name) is not more than 2,500 feet above the general level of the plateau. To all appearance these mountains might be crossed anywhere, some of the passes over the water-parting having a very gradual rise. Judging from the fact that the fall of snow in the early part of 1877 was exceptionally great, Mr. Ryall concludes that the snow line is rarely under 20,000 feet in any part of Hundes.

From a central position the view presented by the whole of the Hundes valley was that of an extensive plain, interrupted here and there by a few groups of isolated low ridges, lying principally east of the valley, and west of the Manasarowar lakes. The poplar is cultivated along the banks of large streams at the lower levels, but beyond this there are absolutely no trees indigenous to this desolate country. The plains are formed of an alluvial deposit, the low ridges on them, and the mountains separating these from the British dominions, are chiefly composed of fossiliferous limestone and shales, and greenstone and other trap rocks.

The houses in Tsaprang and Daba (the chief towns in their districts) are built like those in Ladakh of uncut stones and clay cement, roofed with beams and rafters of poplar wood, the walls being plastered over with white clay. Each of these towns contains a small armed mounted police, who assist in levying duties on merchandise. Taklakhar, the chief town in Purang, is a military outpost containing a garrison of about 100 men, situated on the right of the Map-chu, or *Big River* (known as the Karnali in the Nepalese territories), and to the north of a small stream coming down from the Byans pass. The fort consists of a series of excavations, in a huge mound rising abruptly to a height of 800 feet. Storerooms are situated on the top of these excavations, and contain immense stores of grain and ammunition. Some quantities of grain are said to be no less than 50 years old, the extreme dryness of the atmosphere allowing cereals to be kept almost any time without deterioration. Taklakhar is the last or furthermost post occupied by the Dogras during their brief invasion in 1841, under Zorawar Sing, a graphic account of which is given in Cunningham's "Ladak." West of Taklakhar Fort is Sibling Gonpa, the largest monastery in Nari-Khorsam, maintaining 310 lamas, and a great accumulation of wealth.

The people of Hundes are called Hunias by the inhabitants of the higher valleys in British territory adjoining. They are of Tibetan race, and have the leading ethnological characteristics of that race, high cheek bones, flat noses, broad at the base, rather full lips, narrow and slightly oblique eyes, square and broad shoulders, and middling in stature. They are all, even the young, more or less wrinkled in appearance, and the old are described as hideous from it. They own large flocks of sheep, and herds of cattle and goats, the poorest among them owning five or six yak cows, a few bulls, and from 20 to 30 of each of sheep and goats. The wild yak of the country is always black, and much larger than the domesticated cattle. Both kinds are covered with long hair, at the roots of which large quantities of a description of soft wool, like soft downy moss, grows. This wool is extensively used in weaving blankets and making ropes. The goats of the country are the celebrated shawl goat, which are found all over the region from the Pangong lake to those of Manasarowar. The wool finds its way chiefly into Gartok, where the Kashmiri traders buy it up, a considerable quantity being brought to Amritsar in the Punjab. Lower down the basins of the Indus and Sutlej rivers, a mule yak, a cross between the ordinary cow of the Lower Himalayas and the yak, generally known as the zibu, zoba, or jibu, is principally employed for baggage and agricultural purposes. The yak itself is incapable of standing the summer heat at elevations below 12,000 feet.

The inhabitants of the higher table-lands of Hundes are, generally speaking, nomads, while those residing in the vicinity of arable land, which occurs along the lower parts of the River Sutlej and its tributaries, are semi-nomadic. The dress of the former, in the case of both sexes, is a long loose tunic of sheepskin, with the wool on. Those in better circumstances have their tunics lined with coarse broad cloth, or some similar stout stuff, imported from India. Boots, which are generally worn, are made of felt with soles of raw hide, turned up at the sides. The food of the people consists chiefly of curd cakes, the flesh of live-stock, and a very small quantity of barley meal. The principal beverage of the country is tea, and a spirituous liquor made from fermented barley is also drunk.

Mr. Ryall found that, at elevations of 15,000 and 18,000 feet, the wind blows furiously till about 2 P.M., when it acquires its

greatest speed, of about 35 miles per hour. On the passes it is very little short of a hurricane. On the Balchdhurra pass a Bhotia, a few years before Mr. Ryall's visit, was lifted off the ground and dashed to pieces. The high winds on the plains of Tibet render travelling against it a most toilsome undertaking, and the observation of distant signals a very difficult matter.

The inhabitants of the districts occupying the northern valleys of the Himalayas, from Kumaun on the east to Bashahr on the west, have intimate commercial relations with those of Hundes on the one hand and India on the other. Their districts, taken in order from the west, are Bashahr, Nilang, at the head of the Bhagirathi, in independent Garhwal, Mana and Niti in British Garhwal, and Johar, Darma, and Byans, in Kumaun, these being also known as the Bhotia mehals of Kumaun and Garhwal. The Bashahris carry on trade between Tibet and Amritsar, Ludhiana, and Nurpur, in the Punjab, the trade consisting chiefly in shawl-wool and borax, for which they bring back in return coarsely made cloths, the coarse English broadcloths and cotton goods. The Bashahris are privileged to travel all over Tibet without molestation on the part of the Lhasa or Chinese officials. Others are neither permitted to cross further north than Gartok nor eastward of the Mariam-la pass. The people of Nilang differ in no way from those of Hundes. The districts of Mana, Niti, Johar, Darma, and Byans are also known as the Bhotia mehals of Kumaun and Garhwal. These Bhotias are a people of a most enterprising character. They are of a mixed Tartar origin, the Tartar lineaments predominating. Some of the men and women are decidedly good-looking.

The roads leading through the Johar, Darma, and Byans valleys are barely practicable. The following description of the first of the three roads leading through Milam would apply almost equally to the other two. "It passes along the sides of a deep and "stupendous gorge, overhung mostly by lofty rocky precipices. "The roadway is a mere series of narrow steps built along the "faces of rugged cliffs, and where the side of the latter is too "smooth, the smooth intervals are spanned by narrow planks. "The road is one series of ups and downs, sometimes rising to the "height of a thousand feet above the river, and at others descend-

" ing to its bed. Fatal catastrophes along it are not uncommon. " During the rains and the melting of the snow, to insecurity " under foot must be added dangers overhead from avalanches and " mountain slips, which bring down with them showers of large " rocks. To keep such roads in a barely passable state is a matter " of great toil to the Bhotias. The goods are carried on the " backs of goats and sheep, on ponies, mule yaks or zobas, donkeys " and mules. Often the beasts of burden, particularly the larger " kind, have to be unladen and the loads carried by the men them- " selves, while in some instances the animals are helped over by " means of slings and other contrivances. In spite of such diffi- " culties the Bhotia carries on a fairly remunerative trade with " Hundes and Gartok."

The Bhotia also practises husbandry to a limited extent, but since the country has come under British rule, trade has become so much more secure as to pay better, and agriculture has been greatly abandoned. Of late, however, owing to borax having fallen greatly in price, the people are taking more largely to cultivation.

The villages in the Bhot mehals, and their cultivable lands stand at an average altitude of 10,200 feet above sea level, and consequently little else besides very hardy cereals is cultivated. Wheat is only sown "on chance," and often gets destroyed by early frosts before reaching maturity. Several vegetables are cultivated, and the gooseberry, red and white currants, raspberry and strawberry are indigenous.

The inhabitants of the Mana valley, and of Nilang, deal principally in salt, blankets, and yaks, in exchange for which they give grain. The well-to-do traders of all the above-named valleys bring English piece goods, broadcloths, Delhi-worked brocades, real and imitation gold and silver lace, precious stones, &c., and resort during the beginning of September to the fair at Gartok, where they find a ready sale for such articles.

The Bhot valleys of Kumaun and Garhwal have from a very remote period been occupied by a mixed race, and rumour has it that they were in those days considered as part of Tibet. From the circumstance, however, of their residing longer among the lower hill tribes than among the Hunias, the Bhotias employ a dialect which is more Hindi than Tibetan, though most of them are able to

take that language. The women are almost entirely ignorant of Tibetan. Till recently, the Bhotians enjoyed an immunity from the side of the British Government from all taxation, but now, owing to their increased prosperity, they are assessed, but very slightly.

The dress of the men of the Mana, Niti, and Milan valleys consist of a long tunic of home-spun serge (*puttu*), and trousers of the same material; round their waist they wear cotton cloth tied in folds, and for a head-dress a turban tied over a skull-cap. Both the men and women are extremely fond of ornaments, which in the case of the latter, consist of large solid rings of silver, called *malas*, worn round the neck, necklaces of silver chain and of coins strung together, bangles, festoons of small silver coin suspended from the hair on to the forehead, earrings and nose-rings. Some of them really carry an astonishing weight of silver.

The Bhotias have no written religious tenets, but many Buddhist superstitions are adopted by them. On the whole they abide by Hindu customs of worship, though they are looked down upon by all orthodox Hindus, and celebrate all their religious holidays with feasts and copious draughts of spirituous liquors.

There are five principal passes leading into Hundes from the five different ghats in British territory, and the traffic over them can only be carried on between the 15th June and the 15th October, but they are not supposed to be open for traders from the south until declared so by the Tibetan officials, who first satisfy themselves as to the absence of epidemics among the Himalayan villages.

The articles of commerce brought from Hundes include gold, which is produced from the gold-fields at Thok Jalong (about 100 miles north-east of Gartok), and which exists also about the Sutlej valley in Hundes, and along the shores of the Manasarowar lakes, but very little of which finds its way to India. The export of shawl-wool (*pashm*) to India has fallen off, but it is capable of much enlargement, so much so, that the Bhotia traders say that if they could but get a sufficient sale for pashm in the North-West Provinces, they would not care for the depression in the borax trade. The finest pashm is to be had in the neighbourhood of the Manasarowar lakes; the greatest portion of the product is taken to Gartok, where the Kashmiri merchants from Ladakh buy

it up for the Kashmiri manufactories. Sheep's wool is almost entirely exported to the north and midland districts of the Himalayas, the people of which manufacture it into blankets and serges for home consumption. Tea, which comes only from Lhasa, principally finds its way to the Central Asian markets, Ladakh and Kashmir. A little of it goes to Amritsar, where the Kashmiris resident there chiefly consume it, and some of it is also purchased by the Bhotias, who prefer it to the Indian varieties. A similar prejudice against Indian teas is entertained by the natives of Hundes, and this prejudice is kept alive by Chinese officials, who are extremely jealous regarding the introduction of the Indian teas into Tibetan markets, and who impose a fine on any trader found trafficking in Indian teas. Tea is one of the principal sources of income to the Lhasa Government, and it is not surprising to find them guarding their trade in this article with jealous caution. There are eight varieties of tea which are all said to come from China, and the price of which at Gartok ranges from 1 to 8 rupees. Horses are bred in large numbers in Chumurti, Tsaprang, and Rudok. They are of small stature, seldom exceeding thirteen hands, remarkably sure-footed, being able to climb about the hill sides almost as well as goats, and they find a ready sale at prices varying between 100 and 400 rupees, at the different hill stations, such as Almora, Raniket, Naini Tal, Mussoorie, and Simla. Shawl-wool goats are brought into the Himalayas at the rate of about 3,000 to 4,000 annually, and mostly sold to the Hindus for sacrificial purposes. Their export would be greatly diminished had a larger demand for their wool existed in the North-west Provinces. Salt and borax may be had for the mere digging in the neighbourhood of the gold-fields of Thok Jalung. Broadcloth, fetching 1 rupee 4 annas to 4 rupees 8 annas per yard, is in large demand at Lhasa, as well as cotton goods of all kinds. For indigo there is a lively demand in the markets of Shigatze and Lhasa.

Turquoises are supplied from Yarkand, Khotan, &c. through the Ladakhi traders, and also in small quantities from India. Rubies in small numbers, and occasionally a few emeralds, find their way into Eastern Tibet. Corals and pearls of inconsiderable value are also in some requisition among the better classes of women all over Tibet. Silver in British-Indian coin, chiefly as ornaments, is in much request in Eastern Tibet, but the Bhotias cannot indulge

the taste of the Tibetans in this, except to a limited degree, exchange for grain being much more profitable.

The second Trans-Himalayan exploring narrative in the New Indian Survey Report relates to Mr. T. Kinney's researches while surveying the western sources of the Ganges from Nilang up to the main watershed of the Himalayas, and thence fixing as many points beyond the frontier as possible, and sketching the district of Tsaprang or Chuprang in Hundes.

Mr Kinney left Nilang on the 4th September, carrying his supplies on the back of sheep and goats, and three days later reached a point about 10 miles from the Tsang-chok-la, the eastern of the two passes at the head of the Nilang valley. Here opposition began to be raised by the Hunias to the further progress of Mr. Kinney and his duffadar, but the former was undeterred and visited three stations over 19,000 feet high. Out of regard to the safety of the coolies, Mr. Kinney could never encamp higher than 14,000 or 15,000 feet, so at most of the stations an ascent of over 4,000 or 5,000 feet was involved.

The features of the Nilang valley correspond with the general physical geography of this belt of the Himalayas as observed in other valleys; the main watershed being as a rule lower, and its slopes easier than the southern and more interrupted range on which the highest groups of snowy peaks occur. The Jadh Ganga is the westernmost feeder of the Ganges, and, with the exception of the head-waters of the Tons and Jumna, the westernmost drainage of the Himalayas which falls into the Bay of Bengal, the valleys beyond the western limit of the Nilang valley draining into the Sutlej. The entrance into the Nilang valley from Bhaironghati is through a terrific gorge, the river-bed being encompassed by snowy peaks, from 20,000 to 21,000 feet in height, towering apparently immediately overhead. The *Sanga* or spar bridge over the river in Captain J. A. Hodgson's time (1817) has been replaced by a light suspension bridge higher up over the Jadh Ganga, but as this bridge is 380 feet long, 400 feet above the water, and only 3 feet wide, with a light wire rope as side railing, and sways about considerably, it requires good nerves to enable travellers to cross it. It was built by Mr. O'Callaghan, of the Forest Department, and is a triumph of amateur engineering. Above the junction of the

Mana Gadh, a large glacier-fed stream, the valley gradually opens out and the hills assume a softer and more gentle aspect. The inconvenience due to the highly rarefied atmosphere are popularly ascribed to the sickly scent of the herbage, which produces a certain sense of faintness and a total inability for further exertion in such as are peculiarly subject to its influence. Above the limit of vegetation, which is here about 17,000 feet, the hills become steeper again, and the surface a strangely confused mass of loose rocks intermixed with patches of ice and snow.

Over a spur rising to a height of about 15,000 feet, Mr. Kinney saw the Trans-Sutlej Plain, a plateau apparently sloping gently from the snow-crowned range bounding it to the northward down to the banks of the Sutlej, which are here said to be precipitous cliffs often over 1,000 feet. One of the isolated peaks in this plateau, fixed as K 3, rises at its western extremity boldly and abruptly to a height of about 1,500 feet above the surrounding plains, sloping off gradually towards the east. From where Mr. Kinney beheld it, it bore a fancied resemblance to some monster couched with head erect.

Passing over the detailed topography which is described by Mr. Kinney, we may notice his remarks respecting the customs of the Hunias, in the western portion of Hundes. He observes they have the same uncleanly habits, the same social institutions, and the same fondness for drink as those described by Mr. Ryall. Their *chang*, a kind of beer without any bitter ingredient, is usually made from rye, but occasionally from barley, and is drunk when fresh made. They are very fond of tea, which they drink mixed with butter, and in large quantities. Brick tea is in general use throughout Tibet at about one rupee per pound. The Lhasa Government force the sale of tea on their subjects by issuing a certain quantity of tea to the governor of each province, for which he has to credit them with a fixed sum. He serves this tea out to the people of his district in quantities according to the wealth and standing of the family, whether they want it or not, and fixes the price himself, which includes a large margin for personal profit. Almost every family is obliged to take some tea, the poorest only being passed over.

The Dogkwas of the Tsaparang district are nomads living entirely in tents, and owning large flocks of sheep, goats, and yaks, with

which they roam about, coming up to the grazing grounds on the higher hills during the summer, and in winter descending to the Sutlej plains. They are the chief carriers of the trade of the district.

The Jadhs are professed Buddhists, in race partly Tartar and partly Bashahri, with a strain of Garhwali blood. The former element is due to intermarriage, and the latter probably to the presence of slave girls (who are nevertheless well treated) in the households of the Jadhs. The trade passing up and down the Nilang valley is chiefly in their hands, the Kampas and a few of the Garhwalis from the higher villages also competing with them. The Kampas or nomadic Tibetans are at liberty to travel all over Tibet without question. The chief export over the frontier is grain; the imports are salt, wool, pashmina, yellow arsenic, and a few pieces of pattu. No gold or borax is imported. The estimated value of the trade across the passes at the head of the Nilang valley is from Rs. 25,000 to Rs. 30,000 yearly. The Raja of Tihri formerly levied an *ad valorem* duty of one anna in the rupee on all imports (= $6\frac{1}{4}$ per cent.). In 1878, however, a new import of about 20 per cent. on salt was levied, and the effect of this on the trade is described as most disastrous, the Jadhs having had to borrow money to defray the same.

To the north of Assam, Lieut. (now Captain) Woodthorpe was deputed towards the end of 1877, in company with Lieut. Harman, to explore the Miri hills, the party being joined by Lieut. Maxwell, Assistant Commissioner of North Lakhimpur, who had been in the Miri hills before, knew most of the headmen, and had influence with them. Escorted by about 50 native light infantry and police they advanced on the 6th December 1877 to Ganditula, which is situated on the banks of the Subansiri, about six miles from the plains; here a depôt of stores was established, and a further advance made to two peaks, whence surveying was readily carried on and whence the low hills through which the Dihong forces its way could be readily described. Part of the Kamla river (a principal branch of the Subansiri mentioned by Wilcox) was also explored, but unfortunately an access of fever prevented Lieut. Woodthorpe from following up this new piece of work. The following January they examined the country east of Sidang Mukh, but bad weather

set in relentlessly and prevented the full attainment of desired results. At Pathalipam, a tea garden on the Subansiri, Lieutenants Woodthorpe and Harman parted company, the former proceeding to the Dibong river and Misham hills, while Lieut. Harman set out to measure the discharges of the rivers Subansiri, Dihong, Dibong, and Brahmaputra, and complete the triangulation at the head of the Assam valley.

The results of the Miri hills exploration were that 1,500 square miles, on the scale of 2 miles to the inch, were defined, while a fair knowledge of about 400 square miles of country, on a smaller scale, besides that actually visited. This included a portion of the Dihong river, higher than any part hitherto surveyed, but not high enough to show whether the river is the continuation of the Sanpo or not. The ranges of hills run more or less parallel to each other, east and west of the Subansiri; the outer range is generally low, rising to about 3,000 or 4,000 feet at some points; immediately behind the hills rise at once and very abruptly to between 6,000 and 8,000 feet. They are densely covered with large forest trees, bamboo and cane jungle, and quite uninhabited on the southern slopes, the nearest villages to the plains being at least 12 miles as the crow flies, from the foot of the hills, the paths being few, obscure, and very steep and difficult, especially after rain, when they are so slippery as to be almost impassable. Beyond the Kamla and the Seu rivers to the north the country seemed much more open as regards the lower spurs, villages are comparatively numerous, and the paths more frequent, open, and better made. The rivers abound in fish, which attain a large size in the Kamla and Subansiri, and game, such as deer of various kinds, bears, elephants, &c., are plentiful. The Subansiri is a noble river in the hills, and the gorge through which it emerges into the plains are singularly fine, the banks formed of precipitous masses of rocks, enclosing deep pools in which measurements give a depth of 70 and 80 feet. The river is about 70 yards broad at Ganditula and flows with great velocity; it is only navigable for a few miles above Sidang Mukh. The Miri bridges are suspension ones made of cane. The Miris themselves are a hardy race of middle height and very wiry; they are generally fair and often ruddy, their faces are as a rule flat with high cheek bones, eyes slightly oblique and far apart,

the mouths often very well cut. The males both young and old rarely appear without their helmets, wicker-work hats exceedingly well made, and in shape somewhat resembling a hunting cap with the peak worn behind and curved; as ear ornaments they wear discs and cylinders of silver or other white metal or small brass rings, and among the richer large funnel-shaped metal ornaments. Both men and women smoke to excess from very early age. The Miris manufacture a warm cloth of stout cotton, tags being left on the upper side in imitation of sheep skin. For arms they carry a long straight *dao* or sword and a small knife, also a bow and arrows, and to the north of the Kamla long spears. The women wear a broad belt of finely painted or loose canes round the waist, some two or three bands of which can be dropped at pleasure behind as low as the knee, and thus confine the petticoat in going up hill and in other risky places.

The Miri villages are all very small, the average being eight or nine houses, though large families live in each house. In Bini village there are four houses, and in Ruttina seven, and these are the two villages that a few years ago boasted that they could put 1,000 men into the field. It has fallen to the lot of the Survey lately to prove the falseness of the pretensions of most of the tribes on the frontier with reference to their strength and influence, and there is little doubt that a survey boldly carried into the midst of the dreaded Abors would find those inhabitants much less formidable than the accounts they give of themselves.

The Miri villages are all built on the slopes of spurs, never in elevated positions, which prove that, unlike the Nagas, they live at peace among themselves, and do not have to defend their dwellings. The houses are all raised from the ground on long posts, the walls are of bamboo matting, and the roofs thatched with can or palm leaves. The Miris to the west of the Subansiri are great trappers, both of fish and animals, and set traps near every path. Each man has a certain hunting ground, into which others may not trespass, and the peaks take their names from the owners of the hunting grounds in which they are situated. The Ghasis, to the east, are, on the other hand, great trackers of large game, which they follow up with great persistence for days through the dense and impenetrable jungle.

On starting for the Mishmi hills great inconvenience was caused by an attack of cholera, which carried off some of the natives, and it was not till the 15th March that the actual start was made. Travelling up in a boat and landing frequently at convenient spots, Lieut. Woodthorpe managed to get its course fixed pretty accurately. On the 21st, Nijam Ghat, the principal crossing of the Mishmis and Abors, was reached; it is just at the entrance to the hills, and the river is only navigable for about three miles further up. A few days after Lieut. Woodthorpe entered the hills and did some surveying. He had an opportunity of inspecting the peculiar method of crossing bridges in these parts, which consists of a cane suspension rope stretched across a stream, and secured firmly at both ends, and a series of cane hoops hanging on it, into which the passenger inserts himself. The stoutest of these hoops passes under the small of the back, and the others, which are attached to the big ring or hoop, support the head, shoulders, and thighs respectively. The passenger then passes his legs over the suspension rope, and hanging therefrom in a horizontal position starts for the opposite bank head foremost, grasping the suspension cane with his hands as he goes, and using his feet as well. The nervous part about this method of travelling is the knowledge that no help from others is possible should anything happen in the middle of the bridge. Lieut. Woodthorpe says, however, that it is far pleasanter than might be supposed.

He remarks that Wilcox's description of the Mishmis and their mode of life requires but little to be added to it, but that he is mistaken in describing the Bebaja Mishmis as cannibals. The villages are all very small, and built low down on the slopes and in the ravines. The hills are all very steep, and water is exceedingly plentiful, cascades and little torrents being met with very frequently.

The results of the Mishmi Hills Surveys are—(1) a fairly accurate knowledge of the sources of the Dibong, and the course of its main stream in the hills; (2) an accurate knowledge of its course in the plains, and of about 1,000 square miles of the hills bordering it; (3) an approximate knowledge of an additional 1,100 square miles in the hills. The Dikrang, Diphu, and Digaru rivers are also now well known, and can be entered on the maps with confidence. Several of the Abor villages were seen by Captain Woodthorpe, and

their houses were counted through the telescope, by the aid of which he was enabled to perceive that they are far smaller and more insignificant than generally represented.

An interesting set of photographs of views and groups were taken by Mr. Roberts.

A most noteworthy piece of exploration in Eastern Tibet was accomplished during the year 1878 by one of General Walker's trained native surveyors.

This consists of a survey of the river Sanpo by a new explorer, N—m—g, for a distance of about 200 miles below Chetang, the lowest point previously fixed. N—m—g was employed under the immediate instructions of Lieut. Harman, who has been writing out his journals, and reducing and mapping his observations. The following is a brief provisional account of the journey.

N—m—g was sent to the town of Chetang, the position of which had been determined by Pundit Nain Sing in 1875, with instructions to explore the course of the Sanpo river downwards for as great a distance as possible.

Crossing to the north bank of the river he followed it eastwards for a distance of about 30 miles, down to the point where it is joined by a small river called the Mik-chu from the north-east; here he had to leave the main river and make a considerable detour up the Mik-chu valley and over the Lungla pass, on the range which forms the eastern boundary of the Lhasa basin, then down a valley passing two monasteries, Chokorgye and Thakpo, and rejoining the Sanpo at the town of Gyatsa-Jong. The river had been wending its way through the mountains for a distance of 20 miles while he had been making a detour of over 50 miles. About 30 miles below Gyatsa-Jong he crossed over to the right bank of the river near Thak-Nong-jong, which is situated close to the junction of a river from the south, which is said to pass by the town of Tsari, which Lieut. Harman believes to be identical with D'Anville's Chai. As far as Gyatsa-Jong the course of the Sanpu river is fairly in accordance with Pundit Nain Sing's map of the country which he traversed between Lhasa and Assam; Nain Sing had seen the course of the river for a distance of about 30 miles below Chetang, and he had been informed that from that point onward it flows in a south-easterly direction

into Assam. We now learn that it does flow in a south-easterly direction, but only for a short distance beyond Gyatsa-Jong, after which its course is due east for some 50 miles, and then north-east for about 80 miles. The river reaches its most northern point near the intersection of the meridian of 94° with the parallel of 30°, about 12 miles to the north-east of a place which the explorer calls Chamkar, and which Lieut. Harman identifies with D'Anville's Tchamca.

After attaining its most northern point the river turns due south-east, reaching Gyala Singdong in 15 miles, beyond which place N—m—g was not able to follow it. There, however, he saw that it flowed on for a great distance, passing through a considerable opening in the mountain ranges to the west of a high peak called Jung-la. Beyond this opening the river was said to pass through a country inhabited by savages into a land ruled by the British Government.

Assuming the position of Gyala Sindong to have been fairly well determined by the explorer, its direct distance from the highest point hitherto fixed on the Dihang river in the course of the survey operations in Assam, is only about 100 miles. The height of Gyala Sindong was found by the explorer to be 8,000, showing that the river had fallen about 3,500 feet in 200 miles of distance from Chetang, and leaving a descent of 7,000 feet for the distance of 160 miles down to the junction of the Dihang river with the Brahmaputra; this does not give an excessive slope compared with other Himalayan rivers.

One of the most interesting results of the present exploration is, that it affords an explanation of the probable source whence the Subansiri river draws its large volume of water. The fact of its volume being so large, coupled with the erroneous information derived from Nain Sing as to the supposed south-easterly course of the Sanpu below Chetang, had given rise to a conjecture that the Subansiri was the recipient of the Sanpu. That this conjecture is erroneous has been shown by Lieut. Harman's recent operations for measuring the discharges of the principal affluents of the Brahmaputra. These operations indicate that the volume of the Dihang is from twice to three times as great as that of the Subansiri, so that of the two the Dihang has far better claim to be the recipient

stream. Still the difficulty remained of accounting for the large discharge of the Subansiri from so small a catchment area, and this difficulty is now removed by the discovery of a considerable area inside the great bend of the Sanpu, which may well be one of the two principal basins of the Subansiri and its affluents.

India Office,
August, 1879.

CHARLES E. D. BLACK.

APPENDIX.*

Bombay and Madras Revenue Surveys.

During the year 1877–78 the number of field establishments engaged on survey operations was 35, spread over the Poona and Nasik, Ratnagiri, and Gujarat districts, Southern Mahratta country, Sind, and certain Native States. The operations comprised the measurement of 1,826,209 acres, the classification of 1,538,414 acres, and the settlement of 598,578 acres; the total cost having been 7,67,215 Rs. Of this sum, however, 60,167 Rs. has been or will be recovered from the Native States of Savantwarri, Bhor, and Kolhapur. Town surveys of Dharwar and Hubli were also in progress. The total increase of revenue over past collections from the several settlements introduced during the year is 1,30,199 Rs., which is equivalent to over 25 per cent. Its revenues, which prior to settlement were about 144 lakhs, have now risen to above 176 lakhs. Of the increase about 7 lakhs falls to revision, and proceeds from the imposition of higher rates, and 25 lakhs are chiefly due to extension of cultivation during the currency of original settlements.

The Madras Revenue Survey up to the close of the official year 1877–78 had extended into 18 districts of the Presidency, with an aggregate area of 111,197 square miles. The amount covered by the operations of the cadastral or revenue survey is 47,360 square miles, and by those of the topographical or small scale survey 29,607. Thus there remains out of the area referred to for revenue survey 10,791 square miles, and for topographical survey 23,439 square miles. Under nearly every head, both of field and office work, there has been a large falling off, owing to the withdrawal of a large number of the subordinates for famine duties. The question of extending the revenue survey to the districts of Vizagapatam, Tanjore, South Canara, and Malabar below the Ghauts has not yet

* The reports on the Madras and Bombay Revenue Surveys having but recently arrived in this country are summarized in this appendix.

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been settled. The total area of these tracts is about 29,930 square miles, of which a considerable portion is cultivated under ryotwari tenure.

The surveyors were much scattered during the year under review, a state of things due to demands for special surveys (apart from the regular Revenue Survey) of railway stations, forests, and fuel reserves, Government waste land for sale,. and of unsurveyed remnants of country required to supply continuous and uniform topographical material to the Atlas of India. The early completion of the surveys of Ganjam and Godavari districts, and the withdrawal of parties from other districts, will, however, reduce the number of working parties to five, and so contribute to the economical administration of the department.

The traverse work of the survey was connected with 73 stations of the Great Trigonometrical Survey, and the mean error was only 8·29 feet per mile. The total outlay during the year was 7,39,421 Rs.; of this 88,379 Rs. represent the pay of the staff detached for famine duty, and 22,242 Rs., the cost of estate surveys to be recovered from the proprietors; the cost of the establishment actually employed on survey work for Government was therefore only 6,28,800 Rs.

Digitized with financial assistance from
Government of Maharashtra
on 13 March, 2020